Mr Hardie

SEPTEMBER 1956 · TWO SHILLINGS

Show Guide

Wireless World

ELECTRONICS

Radio · Television

FORTY-SIXTH YEAR OF PUBLICATION

2 new Stabilised Power Supply Units

Three stabilised voltage outputs are provided by each of the two new Ediswan Power Supply Units Types R.1260 and R.1280. In each case two major D.C. outputs variable from 0 to 300v. are provided, plus a low current—D.C. output of reverse polarity.

These units are very suitable power sources for experimental electronic circuits and can frequently be used in place of several single power supplies.

Both units work from normal A.C. mains supply and are designed for standard 19″ rack mounting or for bench use. Meters are included.

SPECIFICATION

Input
200-250v., 40-100 C.P.S.

Outputs

1. High stability D.C. output 0 to 300v. in one range.
   Maximum current: type R.1260 75mA
   type R.1280 150mA
2. High stability D.C. output 0 to 300v. in one range.
   Maximum current (both types) 75mA
3. High stability D.C. output -200v. non-variable.
   Maximum current (both types) 25mA

4 and 5. Two independent 6.3v. 4 amp A.C. unstabilised outputs, both centre tapped.

Notes:

A. The negative terminals of the two 300v. supplies and the positive terminal of the 200v. supply are common.

B. Either output 1 or 2 may be taken with output 3 to give a supply of 200-500v. at 25mA.

Stability
With change of mains input voltage (outputs 1, 2 and 3):
A change of 10v. in the mains supply results in an output change of less than 0.1v.
With change of load: A change from zero to full load results in output voltage changes as follows:

Outputs 1 and 2 ... Less than 0.3v.
Output 3 ... Less than 0.1v.

Output Resistance (Outputs 1, 2 and 3).
Less than 3 ohms.

Ripple

Outputs 1 and 2 ... Less than 2mV R.M.S.
Output 3 ... Less than 4mV R.M.S.

Output Circuits

All outputs isolated from earth, and any point may be connected to earth. All terminals can be worked at up to 500 volts from earth. Outputs 1 and 2 may be switched without affecting any of the heater supplies.

Meters
Each 300v. supply has a meter which can be switched to be a voltmeter or milliammeter.

Mounting
R.1260 and R.1280 are both suitable for standard 19″ rack mounting, or for bench use.

Price

R.1260—£78 nett
R.1280—£86 nett
Bench stand for R.1280—£2 nett

Further information on this and other Ediswan Stabilised Power Supply Units on request.

EDISWAN
RADIO DIVISION

SPI32

THE EDISON SWAN ELECTRIC CO. LTD., 155 CHARING CROSS ROAD, LONDON, W.C.2
Member of the A.E.I. Group of Companies.

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Wireless World

ELECTRONICS, RADIO, TELEVISION

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SEPTEMBER 1956

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Transistors for the Experimenter

As in previous years, one of the Mullard contributions to the 1956 Radio Show is a stand supplying technical information to all those who use valves and other electronic devices—whether at work or for their hobby. These enthusiasts are often described generally as home constructors, but many professional engineers, dealers, service engineers, teachers, and students are included among their number. Our publication on transistors this year is called "Transistors for the Experimenter". Deliberately the rather vague term 'experimenter' has been introduced to cover a wide range of interests and requirements. The title does not mean that the booklet has a restricted appeal: on the contrary, nobody need feel left out.

Transistors give us all the opportunity to start afresh and to follow the subject through from its beginnings. A very large part of the booklet has therefore been devoted to the more instructional aspects of transistor applications. More important, many circuits are given in the later pages. Most of the circuits are new, and the text has been completely revised and made several times larger than that given in "Junction Transistors for the Home Constructor". Material which has appeared in earlier advertisements in this series has been included.

Particular interest this year centres round the low power output OC72 junction transistor. Two circuits for a 200mW amplifier are supplied, one for operation from a 6-volt supply and the other for 4.5V. The output and sensitivity are sufficient for small portable equipment such as gramophones and personal radio receivers. A crystal pick-up will drive the amplifier fully. A number of possible r.f. front-ends for the amplifier are described, though the sensitivity requirements of these r.f. circuits are such that in general the amplifier will not be driven to its full output.

Circuits are included which show how the personal receivers can be made in a form which feeds into an insert earpiece. Other new circuits are: a two-transistor R-C coupled sinusoidal oscillator; a symmetrical multivibrator; a bridge balance indicator; and a sensitive e.h.t. voltmeter.

Each circuit is accompanied by notes which show, for example, the possible uses and operating ranges of the equipment. An explanation of the mode of operation of the circuit is given to help the reader grasp the applicational information in the rest of the booklet.

After the circuit descriptions the remainder of the booklet is fairly general. The design of transistor circuits is by no means a hit-or-miss or empirical affair. Although reasonably full design procedure is described to show not only how it's done, but that it can be done, the more immediate and practical methods are not neglected.

Following some introductory notes on the circuit configurations etc., the most important new material comes under the following headings. *Small-signal a.f. stages* shows how small-signal parameters are applied to the earlier stages of amplifiers. *D.C. stabilising* gives a full treatment of this topic, including the preferred system using a potential divider and emitter resistor, and shows how production spreads are allowed for. *Large-signal a.f. stages* is devoted chiefly to Class B and the design of the output stage of the 200mW amplifier, with examples. Further sections indicate the problems encountered at *high frequencies* and in *oscillator* and *switching* circuits etc. *Transistor data* contains a discussion on the choice of limiting values.

"Transistors for the Experimenter" can be obtained at our Radio Show stand or after the show from the address below. No charge is made for this publication.

D 2 A

DEALERS: SERVICE ENGINEERS: HOME CONSTRUCTORS: You are invited to visit the Mullard technical information service in Demonstration Room D2A.

TAPE RECORDER ENTHUSIASTS: Circuits for recording and playback amplifiers are on view. Two circuits are described, with constructional information, in a free booklet "Circuits for Tape Recorders". One circuit is for a unit to feed into a high quality amplifier such as the '5-10'. The other unit is self-contained and gives an output of about 3 watts.

AMPLIFIER CONSTRUCTORS: Built-up amplifier circuits and the f.m. tuner unit are specially displayed. Constructional details of these circuits are given in "High Quality Sound Reproduction" (on sale, price 3s. 6d.). A supplement giving additional information is being issued free. The free leaflet on the 3-valve 3-watt amplifier is being re-issued and shows an improved and slightly modified circuit.

TRANSISTOR STUDENTS: Get your free copy of "Transistors for the Experimenter". Many circuits are described including miniature receivers, pre-amplifiers, and 4.5-volt and 6-volt versions of the 200mW amplifier.

Something for Everybody: Demonstration Room D2A is divided into two parts. General technical enquiries will be answered in an open 'forecourt'. Literature is distributed here, and there is also a display of non-working equipment built from Mullard circuits. Working models of the circuits are located in a demonstration room leading off the forecourt. Constructors can examine and compare the circuits and discuss problems with the engineers.

Mullard

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Wireless World

SEPTEMBER 1956

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Recording From the Telephone

EVERY telephone subscriber knows that the G.P.O. instrument in his home or office remains the property of the Postmaster-General, and must not be tampered with. But most of us probably believe that the P.M.G., if he does not officially approve, turns a blind eye on the use of telephone attachments depending entirely on acoustic or inductive couplings, and so involve no mechanical tampering or the making of metallic electrical connections.

Apparently that belief is wrong. In *Wireless World* for July we published a description of a simple telephone answering machine. It seemed to satisfy the "no tampering" rule, and the descriptive article carried an implication that the device would meet Post Office requirements. The G.P.O. now tells us that implication was incorrect. The device described in our article has not been submitted for approval; further, in the official view, a reliable answering/recording service can only be provided by a self-contained appliance directly wired to the telephone installation.

Any telephone answering machine of necessity makes use of a two-way coupling to the Post Office instrument and may also present other electrical and mechanical problems. Instead of commenting on the Post Office statement just quoted, we will consider a much simpler kind of telephone attachment—the tape recorder pick-up. This consists merely of an inductor for attachment (usually by a sucker) to the body of the telephone instrument in order to provide an inductive coupling with the built-in transformer, and thus to allow the recording of incoming messages. These pick-ups, in one form or another, are offered by several manufacturers of tape recorders and are in widespread use. But do they have the official blessing of the Post Office?

The relevant section of "The Telephone Regulations, 1954," reads:—

"A subscriber shall not, without the written consent of the Postmaster-General:—

(*a*) alter or remove an installation or any part thereof, or obliterate or deface any marks thereon;

(*b*) make any attachment to an installation, or place any thing in electrical connection therewith;

(*c*) place or use in any manner or position in relation to an installation any thing that may in the opinion of the Postmaster-General have a harmful effect on the installation or on its use for the purposes for which it is provided; or

(*d*) place or use any thing (unless provided for the purpose by the Postmaster-General) in such a manner or position in relation to an installation that it transmits or enables to be transmitted any message or other communication to or from the installation. . . ."

According to the strict letter of the Regulations there is little doubt that even a recorder pick-up would rank as an "attachment," though it might conceivably be admitted under paragraph (*c*) if it were considered to have no harmful effect. *Wireless World* has accordingly questioned the G.P.O. Engineering Department on that point, and finds the attitude to be distinctly frigid towards inductively coupled pick-ups. Only one tape recorder attachment has so far been approved, and that uses a directly wired connection, which is considered to be necessary. As to "harmful effects," the main trouble—and that admittedly is not common—is said to be due to the transfer of h.f. bias currents from the recorder to carrier circuits, with consequent heterodyning. Official objections to inductive pick-ups are apparently more concerned with their alleged ineffectiveness and the fear that their use may bring discredit on the telephone service. Incidentally, our experience tends to show such fears are unjustified, as good recordings can be made after very little practice.

Although we do not question the superiority of the direct electrical connection for regular use, to insist on it seems greatly to restrict the applications of recorders as telephone adjuncts. Those who have only an occasional need for recording messages will probably be unwilling to go to the trouble and expense of having a break-in point installed by Post Office mechanics, though that procedure would not deter regular users. The inductive method of coupling has the great advantage of simplicity and cheapness and it seems a pity that the Post Office should turn its face too resolutely against it until the possibilities of overcoming the deficiencies have been explored. Transfer of bias current to the telephone lines could surely be prevented quite easily; we should imagine that the number of modern recorders in which a significant h.f. voltage is developed across the input terminals must be very small.

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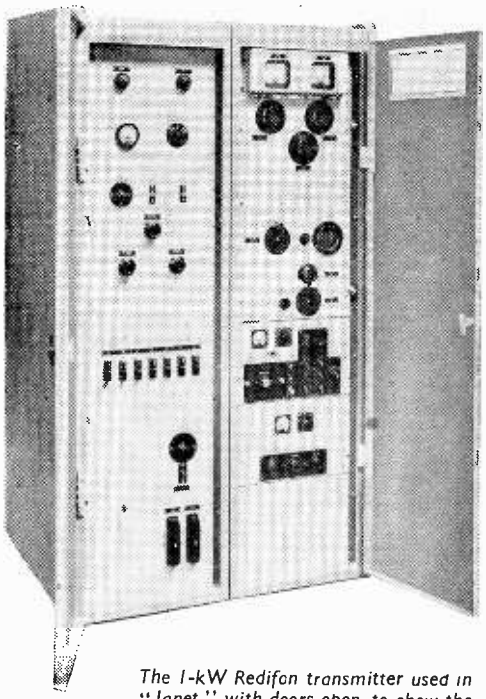
Communication *via* Meteors

LOW-POWER ALTERNATIVE TO IONOSPHERIC SCATTER

TELEGRAPHIC radio signals can be transmitted up to 1,000 miles by a new v.h.f. technique in which the waves are reflected from the ionized trails of meteors in the upper atmosphere. Developed by the Canadian Defence Research Board under the code name "Janet," the method is notable for requiring only a small radiated power and uses transmitters of about 1-kW output. It therefore offers a very economical alternative to the high-power ionospheric scatter system, with small, low-cost stations and simpler aerial arrays. Moreover, it appears to be unaffected by electrical and cosmic disturbances, while the spasmodic nature of the reflecting medium ensures a high degree of privacy. Reliability in transmitting messages is claimed to be 95%.

The meteors, which are about the size of pin-heads, plunge into our atmosphere in the region of 60 miles up at a speed of roughly 100,000 m.p.h. They are burnt up rapidly in this process and as a result leave behind trails of ionized particles up to six miles long. Radio astronomers have been using these trails as reflecting media to measure the speed of the meteors by radar methods since about 1946. It has been estimated that some 8,000 million of the meteors enter our atmosphere each day, and there are hundreds of usable trails formed every hour between any two fixed points at the right sort of altitude.

Nevertheless the meteors are essentially spasmodic in their appearance, and the equipment of "Janet" has to be specially designed to take advantage of them when they come. A complete communications circuit has two ground stations, each with a transmitter and a receiver and carefully aligned directional aerials. The transmitters and receivers are on continuously, but no messages are passed until a meteor forms a trail across the spot in the atmosphere at which the aerials are directed. When this happens and the path becomes "conductive," the two receivers pick up a signal and automatically switch on devices which feed tapes carrying telegraphic messages to their respective transmitters at very high speed.



The 1-kW Redifon transmitter used in "Janet" with doors open to show the controls.

Signal Strength

Actually, the signal received when there are no meteors is approximately 0.1 μV and this is just about enough to tune the equipment in readiness. When the waves are reflected by a meteor trail this signal increases by some 60-80 dB. The frequency of operation is in the range 30-60 Mc/s, while the aerials used so far have been Yagi types with a gain of 10-12 dB.

Because each meteor trail can only be used for a short period—varying from milliseconds to a few seconds—the messages have to be stored before transmission (by magnetic tape equipment) then sent in short, fast bursts. The ingoing speed of messages to the store is 40 words per minute, while the actual transmission speed in the bursts can be as high as 2,000 w.p.m.—which, taking into account the breaks between meteors, works out to an average speed of 40 w.p.m. At the receiving end the incoming bursts of messages are again recorded on magnetic tape (since the code characters are too fast for standard teleprinter equipment) and then printed at normal speed in the intervals between transmissions.

There is a danger, of course, that some meteor trails may prove of too short a duration for effective

EDITORIAL ASSISTANT WANTED

Wireless World invites applications for the post of editorial assistant. The tasks, which are varied and interesting, could be fulfilled by a man aged 25-30 with a good grounding in physics and some experience in radio and electronics. The post should appeal to one who finds satisfaction in clarifying his own thoughts through the act of writing, and who would appreciate the atmosphere of technical journalism, a field offering exceptional opportunities for keeping abreast of developments.

Applications should be addressed to the Editor, *Wireless World*, Dorset House, Stamford Street, London, S.E.1.

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transmission and that the few code characters radiated in such bursts may not be properly received. Naturally, the equipment cannot "know" in advance how long the trails will be effective, so a device has been incorporated in the system which measures the duration of each burst and, if it proves to be unreasonably short, causes that part of the message to be repeated. In this way the high standard of reliability is maintained.

Transmitting Equipment

The 1-kW transmitters for use in "Janet" have been designed and built by Redifon (see photograph), and it is a notable achievement that they were in operation in Canada within six months of the date of the order being received in London. They are fairly conventional in design, having two crystal-controlled fixed frequencies available, normal drive circuits and Class-C push-pull output stages. The modulation is a high grade type of a.m., special precautions being taken to ensure that the short bursts of high-speed pulses are not mutilated by transient distortion. Further transmitters are being built for the Canadian and British governments and for N.A.T.O.

Low-power tests with "Janet" have been going on for some two or three years in Canada, and since August, 1955, the experimental transmissions have been on the relatively high power given by the 1-kW transmitters. Undoubtedly the system will bring considerable relief to the heavily overcrowded h.f. communications band. It is too early yet to say how many channels will become available, but the number should be quite large as the system occupies only a narrow bandwidth. Possible interference with television will, of course, have to be watched.

I.E.E. Awards To Authors

A LARGE number of the premiums awarded by the Institution of Electrical Engineers for papers read or accepted for publication during the 1955/1956 session will be received by authors of papers on radio and electronics.

The Kelvin premium (£25) is awarded jointly to A. Stott and P. E. Axon (B.B.C.) for their paper "The subjective discrimination of pitch and amplitude fluctuations in recording systems"; the Blumlein-Browne-Willans premium (£20) goes to R. S. Webley, H. G. Lubszynski and J. A. Lodge (E.M.I.) for "Some half-tone charge storage tubes"; the Fahie (£10) is shared by Captain C. F. Booth (G.P.O.) and B. N. MacLarty (Marconi's) for "The new h.f. transmitting station at Rugby"; the Heaviside (£10) to I. A. Harris (M.o.S.) for a paper on co-axial resistor mounts and the Webber (£10) to W. C. Bain (D.S.I.R.) for two papers on direction-finding systems.

Recipients of the Radio and Telecommunication Section premiums are L. R. F. Harris (G.P.O.) who receives the Duddell (£20) for his paper on electronic telephone switching; Professor A. L. Cullen and J. C. Parr the Ambrose Fleming (£10) for "A new perturbation method for measuring microwave fields in free space." £10 premiums also go to E. D. R. Shearman (D.S.I.R.) for two papers on ground back scatter and G. B. B. Chaplin (Harwell), R. E. Hayes and A. R. Owens (Manchester University) for a series of papers on transistor circuits. Three £5 section premiums were also awarded.

One of the £10 graduate and student premiums goes to G. A. Gibson (G.E.C.) for his paper on pulse circuitry.

BOOKS RECEIVED

Transistors in Radio and Television by Milton S. Kiver. Takes the reader in easy stages from electron theory through an elementary explanation of transistor physics to practical applications of transistors in sound and television receivers. Includes chapters on experiments designed to give familiarity with transistor behaviour and circuit servicing procedure. Pp. 324; Figs. 261. Price 37s 6d. McGraw Hill Publishing Co., Ltd., 95, Farringdon Street, London, E.C.4.

Einführung in die Siebschaltungstheorie der elektrischen Nachrichtentechnik by Richard Feldtkeller. Revised fourth edition of an introductory treatise on filter circuits for telecommunications. Pp. 199; Figs. 191. Price DM25.40. S. Hirzel Verlag, Birkenwaldstrasse 185, Stuttgart N.

Studien über Traveling-Wave Tubes by Dr. Gerhard E. Weibel. Mathematical exposition of travelling wave tube theory and a detailed description of a tube designed for experimental study and demonstration. Pp. 93; Figs. 25. Price 9.35 Swiss francs. Verlag Leemann Zurich, Arbenzstrasse 20, Postfach Zurich 34.

Servicing Record Changers by Harry Mileaf. Analysis with simplified diagrams of the basic functions of record changer mechanisms of various makes with hints on repair and adjustment. Pp. 224; Figs. 173. Price $2.90. Gernsback Library Inc., 154, West 14th Street, New York 11. Obtainable in this country through the Modern Book Company, 19-23, Praed Street, London, W.2. Price 23s.

Plastics Engineering by F. T. Barwell, Ph.D., D.I.C., B.Sc.(Eng.), M.I.Mech.E., A.M.I.E.E. Succinct introduction to the basic methods of fabricating plastics and to the standard tests for mechanical and electrical properties, being an extract (Chapt. XIX, Part I) from "Modern Workshop Technology." Pp. 43; Figs. 12. Price 3s 6d. Cleaver-Hume Press, Ltd., 31, Wrights Lane, London, W.8.

Observational Errors by E. W. Anderson and J. B. Parker. Explanation for the practical man of the language and methods of statistics as applied to the interpretation of navigational observations. Pp. 28; Figs. 23. Price 5s. John Murray, 50, Albemarle Street, London, W.1.

Mechanical Design for Electronic Engineers by R. H. Garner, B.Sc.(Eng.), A.M.I.E.E., A.M.I.Mech.E., A.M.Brit.I.R.E. Students guide to the methods and materials available for housing electronic equipment, with a chapter on codes of practice and standards specifications relevant to the subject. Pp.223+vii; Figs. 130. Price 25s. George Newnes, Ltd., Southampton Street, London, W.C.2.

"Electronic Machine-Tool Control"

Correction.—On page 384, penultimate paragraph, of this article in the August issue, the E.M.I. control system was wrongly stated to be shown on the stand of W. H. Kearns and Co. This should actually be Wadkin, Ltd.

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WORLD OF WIRELESS

Organizational, Personal and Industrial Notes and News

V.H.F. Sound Broadcasting

A FURTHER six v.h.f. stations, bringing the total to sixteen, are to be built during the next two years by the B.B.C. With the introduction of these stations, the v.h.f. service will be within reach of 96% of the population.

The location of the new stations and the frequencies on which they will operate are given below. It is planned to have the first four in operation by the end of next year.

The Anglesey station will replace the temporary transmitter at Penmon at present radiating the Home Service on 94 Mc/s.

Only five of the original ten stations authorized are at present in full service—Wrotham, Pontop Pike, Divis, Meldrum and North Hessary Tor which came into service on August 7th on 88.1, 90.3 and 92.5 Mc/s. The B.B.C. plans to have the others, Norwich, Sutton Coldfield, Holme Moss, Blaen Plwy and Wenvoe (where a temporary transmitter is at present operating on 94.3 Mc/s), in service by the end of this year.

	Light (Mc/s)	Third (Mc/s)	Home (Mc/s)
Rowridge, Isle of Wight ...	88.5	90.7	92.9
Kirk o'Shotts, Lanarks.	89.9	92.1	94.3
Sandale, Cumberland	88.1	90.3	92.5 (North) 94.7 (Scottish)
Corwen, N. Wales	—	—	94.9
Anglesey	89.6	91.8	94.0
Rosemarkie, Moray Firth ...	89.3	91.5	93.7

Long-Distance Closed-Circuit TV

REMOTE control has frequently been employed to perform an opening ceremony, but not until this month has television been used in this country to enable the opener and the assembled guests to see the plant started and be "conducted" round the works whilst remaining some 200 miles away. The occasion was the official starting up by the Home Secretary of Britain's first "bulk" oxygen plant at Margam, near Swansea.

Television cameras, installed by Marconi's, at both the plant of the British Oxygen Co. and the works of the Steel Company of Wales, to which the oxygen is piped, were linked by radio to the G.P.O./B.B.C. cable from Wenvoe to London and fed to a number of monitors in the London office of the British Oxygen Company.

By fitting the television camera with "dark glasses" the interior of a furnace, into which oxygen was being injected, was clearly seen—a rigorous test for the camera; the contrast ratio of light-to-dark being of the order of 500:1 compared with a normal studio ratio of 20:1.

Sales at Home and Abroad

ALTHOUGH retail sales of sound and television receivers were higher in June than the previous month, the total sales for the first six months of the year were well below those of the same period in 1955. Television receiver sales were down •14%, sound receivers 19% and radiogramophones 40%. The comparable figures for the first half of each year are tabulated below:—

	Television		Sound		Radiograms	
	1956	1955	1956	1955	1956	1955
January...	85,000	103,000	66,000	98,000	18,000	35,000
February	81,000	98,000	66,000	99,000	15,000	33,000
March ...	71,000	85,000	72,000	95,000	13,000	24,000
April ...	62,000	75,000	65,000	79,000	14,000	16,000
May ...	53,000	62,000	70,000	75,000	11,000	15,000
June ...	61,000	58,000	80,000	74,000	11,000	13,000
	413,000	481,000	419,000	520,000	82,000	136,000

Whilst home sales decreased during the first six months of the year, overseas sales of sound and television receivers increased from £1.83M to £1.96M. The increased exports for the other main groups of the industry were even greater—sound reproducing equipment £3.67M (£2.57M); components £4.05M (£3.46M); valves £1.55M (£1.38M); capital goods £7.94m (£6.36m).

The overall total for the half-year was £19.17M compared with £15.6M for the same period last year.

PERSONALITIES

Sir Archibald Gill, K.B., B.Sc.(Eng.), M.I.E.E., engineer-in-chief of the Post Office until his retirement in 1951, has joined British Telecommunications Research Limited as director and general manager. Sir Archibald, who entered the Post Office engineering department as an assistant engineer in 1913, was for some time in charge of the radio experimental station at Dollis Hill. He will be responsible for the general administration of the research establishment at Taplow, Bucks, which was formed jointly by B.I. Callender's Cables Limited and the Automatic Telephone and Electric Company Limited ten years ago to promote telecommunications research and now has a staff of some 350.

F. E. Jones, M.B.E., B.Sc., Ph.D., A.M.I.E.E., who, as mentioned in our August issue, recently retired from Government service, has joined the board of Mullard Limited. Dr. Jones was on the staff of the Telecommunications Research Establishment from 1940 to 1952 and was appointed an M.B.E. in 1945 for his work on "Oboe," the wartime blind-bombing system. For the past four years he has been at the Royal Aircraft Establishment, Farnborough, where he was deputy director (equipment). Before entering Government service he held an appointment at King's College, London, where he graduated. He is 42.

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J. D. Stephenson, M.Sc., Ph.D., M.I.E.E., a director of the Mullard Radio Valve Company and Mullard Blackburn Works Limited, has also been appointed to the board of the parent company—Mullard Limited. After four years' research work at Durham University, where he took degrees in physics, applied science and electrical engineering, Dr. Stephenson joined the Mullard organization in 1933 and for the past ten years has been in charge of valve manufacture for the group.

H. A. Lewis, M.B.E., T.D., B.Sc.(Eng.), A.C.G.I., M.I.E.E., has resigned from Marconi's Wireless Telegraph Co., where he was manager of the broadcasting division, and has joined Electric and Musical Industries as personal assistant to E. J. Emery, managing director of the domestic electronics division. He had been with Marconi's since 1948. After taking his degree at Imperial College, University of London, in 1933, Mr. Lewis, who is 43, joined the B.B.C. as a student apprentice and was subsequently appointed to the newly-formed television section of the station design and installation department. During the war he was responsible for the formation and expansion of the branch of R.E.M.E. concerned with the installation and maintenance of Army telecommunications and radar equipment.

D. G. Smee, M.B.E., Assoc.I.E.E., is the new manager of Marconi's broadcasting division in succession to H. A. Lewis. Prior to war service, first in Royal Signals and then in R.E.M.E. rising to the rank of major, he was for seven years in Marconi's research laboratories. He was appointed an M.B.E. in 1945 for his work in the Middle East and Italian theatres of war, where he was responsible for the maintenance and repair organization of Army telecommunications and radar equipment. Mr. Smee rejoined Marconi's in 1946 and has held various positions including that of assistant commercial manager since 1951.

G. E. Condliffe, O.B.E., B.Sc., M.I.E.E., has relinquished the position of managing director of E.M.I. Research Laboratories Limited, which he has held since 1951, to become research and technical consultant to J. F. Lockwood, the chairman and managing director of Electric and Musical Industries Limited. Mr. Condliffe, who graduated at Manchester University, joined the research laboratories of the Gramophone Company (now in the E.M.I. Group) in 1929 and during the war was concerned with Government radar projects. He was appointed to the technical sub-committee of the Television Advisory Committee in 1953.

Owing to the illness of R. **P. Browne,** O.B.E., B.Sc., secretary of the Radio Industry Council, who has been in hospital for the past two months, his deputy, **G. B. Campbell,** has been appointed acting secretary. Incidentally, during the Radio Show all R.I.C. business will be conducted from Earls Court.

Denis Taylor, M.Sc., Ph.D., F.Inst.P., the new chairman of the measurement and control section of the I.E.E., is head of the electronics and instrumentation division at the Atomic Energy Research Establishment, Harwell. He went to A.E.R.E. in 1946 after seven years' service at the Telecommunications Research Establishment, where he played a leading part in the development of radar. For his work as a member of Sir Robert Watson-Watt's team, and especially for the development of G.C.I. (ground controlled interception), he was awarded £2,400. Before joining the Watson-Watt team at Bawdsey in 1939, Dr. Taylor was a lecturer at Hull Technical College and at Croydon Polytechnic.

D. R. Parsons, M.I.E.E., M.Brit.I.R.E., who for the past eight years has been chief engineer of Rediffusion (North-East) Limited, has been transferred to Rediffusion (Merseyside) Limited as general manager. He was previously with Eddystone, Whiteley Electrical and the G.E.C.

R. H. Hammans (G2IG), president of the Radio Society of Great Britain, was elected to preside over the recent International Amateur Radio Union conference held at Stresa, Italy. This was the second triennial conference of I.A.R.U. Region 1 societies which was attended by representatives of seventeen countries. Mr. Hammans is chief engineer of Granada TV Network—one of the I.T.A. programme contractors. **H. A. M. Clark,** B.Sc.(Eng.), M.I.E.E., (G6OT), R.S.G.B. representative on the technical committee of the conference, was elected chairman of that committee.

OUR AUTHORS

John M. Beukers, contributor of the article in this issue describing a switch-tuned f.m. unit, is now in the advanced development laboratory of Standard Telephones and Cables, having served a two-year apprenticeship in the company's radio division. He studied at the Northampton Engineering College, London, where he obtained his B.Sc.(Eng.) degree and a college diploma. Mr. Beukers won this year's B.S.R.A. committee prize with a pre-tuned f.m. receiver and a gramophone pre-amplifier.

J. S. Belrose, the writer of the article on a selective band-pass i.f. amplifier, graduated from the University of British Columbia in 1950 with a B.A.Sc. degree. From 1951 to 1953 he was in the radio physics laboratory of the Defence Research Board in Ottawa, Canada, where he was concerned mainly with the design of transmitting and receiving aerials and equipment for f.s.k. teleprinter transmission. In 1953 Mr. Belrose came to this country and has since then been a research student at the Cavendish Laboratory, Cambridge, experimentally studying the reflection of long waves from the ionosphere at both steep and oblique incidence.

Dr. F. E. JONES.

Dr. J. D. STEPHENSON.

H. A. LEWIS.

D. G. SMEE

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OBITUARY

L. H. Bainbridge-Bell, O.B.E., M.C., M.A., M.I.E.E., whose absorbing personal interest was the presentation of technical information, especially in relation to circuit diagrams on which he has contributed to *Wireless World* (sometimes under the nom-de-plume Symbol Simon) died on August 7th, aged 63. Since his retirement in 1953 from the Admiralty Signal and Radar Establishment, which he joined in 1939, he had been a committee secretary in the electrical section of British Standards Institution. From 1927 to 1936 he was at the Slough radio station developing the c.r. direction finder for atmospherics and ionosphere-sounding apparatus. During this period he was co-author with Watson-Watt and Herd of "The Cathode-Ray Oscillograph in Radio Research." For his "contributions to the development of radar installations" as a member of Sir Robert Watson-Watt's team, he was awarded £2,400.

IN BRIEF

Television licences must now exceed six million for during June, the last available figure, the total increased by 58,547 to 5,922,020. The Midland Region, like the London Region, now has more television than sound licences—1,021,171 compared with 1,011,463. The overall total of broadcast receiving licences at the end of June was 14,332,856.

Awards to Inventors.—The fourth and final report of the Royal Commission on Awards to Inventors (H.M.S.O. Cmd. 9744) lists 115 claims heard by the Commission since November, 1952. Among the radio claims not previously referred to in these pages is one for the disc-seal triode for which E. H. Ullrich, Dr. C. N. Smyth, S. G. Tomlin and J. Foster received £2,500. Awards of £750 for the development of Yagi aerials, £500 for a capacitance switch and phasing switch and £1,500 for parabolic reflector type aerials were shared by R. V. Alred, J. F. Coales, M. J. Jones, W. T. Davies, E. F. Daly, A. Dooley and K. R. Soar.

I.T.A. Increased Power.—The e.r.p. at both Croydon and Lichfield has been doubled by operating two transmitters in parallel. The Croydon station's e.r.p. is now 120 kW and Lichfield 100 kW. The e.r.p. of the Midland station will eventually be increased to 200 kW—probably in the autumn. The transmitters at Croydon were installed by Marconi's and at Lichfield by Pye.

Lifeboat Radio.—The Royal National Life-boat Institution is to install v.h.f. radio-telephones in 50 lifeboats to enable crews to keep in touch with pilots of helicopters and other search and rescue aircraft. At present communications have to pass through the G.P.O. coast stations or coastguards. The equipment, which will operate on the "search and rescue, scene of action" frequency (138.78 Mc/s) used by the Royal Naval Air Service and the R.A.F., is being supplied by the British Communications Corporation.

A two-day exhibition of their receivers is being held by Champion Electric Corporation in the ballroom at the Mayfair Hotel, London, W.1, on August 23rd and 24th. Complimentary tickets are obtainable from Champion at 8, Eccleston Street, London, S.W.1.

"Ferroresonant Computing Circuits."—The authors of this article in the July issue ask us to state that the following two references should be added to the bibliography: British Patent No. 749,383 (R. H. Baker: assigned to N.R.D.C.); British Patent Application 5828/56 (R. S. Arbon and G. Phylip-Jones).

"Broadcasting in the U.S.S.R."—In para. 4, p. 381, July issue, there was some confusion between cause and effect. In fact, films and O.Bs preponderate in Soviet television programmes *because* available studio space is at present small. Also, on p. 380, the frequency of the latest radio link should be 3,000 and not 300 Mc/s.

A memorial plaque bearing the inscription "John Logie Baird, A.R.T.C.—1888-1946. A former student of the college. This plaque was erected to commemorate his inventive genius and outstanding contributions to the development of television", was unveiled by the Postmaster General at the Royal Technical College, Glasgow, in July. It is the first of three memorials sponsored by the college; the others being a Baird lecture and a Baird prize to be awarded annually in the department of electrical engineering.

Brit. I.R.E.—The first London meeting of the session will be held at 6.30 on September 26th at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, when Dr. H. W. Loeb will read a paper on "Some aspects of transistor progress."

Teacher Training.—Garnett College, in the New Kent Road, London, S.E.1, still has a number of vacancies in the nine-months full-time course starting in September to train teachers of technical subjects for work in technical schools and colleges. It is stressed that it is a course of teacher training and does not deal with specific technical subjects, students being expected to possess the necessary engineering qualifications. The course leads to the teachers' certificate of the University of London Institute of Education.

Next year's **British Plastics Exhibition** (July 10th to 20th) is to become an international show. The exhibition and convention, organized by *British Plastics* in co-operation with the British Plastics Federation, will now occupy both the Grand and National halls at Olympia—an area of 250,000 square feet compared with 90,000 square feet at the last exhibition in 1955.

A programme has now been prepared for the **Air Traffic Control Convention** to be held at Southend-on-Sea on October 4th and 5th. Details can be obtained from the Guild of Air Traffic Control Officers, 118, Mount Street, Berkeley Square, London, W.1. The main objective of the convention is to bring together not only those who operate and use the air traffic control services but those who design and manufacture the equipment employed.

Amateur Television Convention.—This year's convention of the British Amateur Television Club will be held at the Bonnington Hotel, Southampton Row, London, W.C.1, from 10 a.m. to 7 p.m. on October 27th. It will include displays and demonstrations of members' equipment. Further particulars and admission tickets (price 5s) are obtainable from D. S. Reid, 4, Bishop Road, Chelmsford, Essex.

BUSINESS NOTES

Harbour radar is to be installed by **Decca** at the Southampton Harbour Board's Calshot Signal Station. The equipment (Type 32), which employs a beam of only ⅓rd degree and 1/20th microsecond pulse, will provide a radar picture of the Port of Southampton and its approaches.

Sound Equipment, Limited, of 5, Great Newport Street, London, W.1, which was a member of the Rank group, has become a wholly-owned subsidiary of the British Thomson-Houston Company and its name is to be changed to BTH Sound Equipment, Limited. The company will continue to supply and service cinema equipment and will also broaden the scope of its activities in this field.

As foreshadowed in our July issue, **McMichael Radio** has been taken over by Radio and Allied Industries, Limited, manufacturers of Sobell receivers. The McMichael office in the Strand, London, has been closed and the company's activities centred at Langley Park, Slough, Bucks. (Tel.: Slough 22201.) The service department will remain at The Plaza, Iver, Bucks. (Tel.: Iver 1171.)

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Dagnall and Kendall, Limited, of Cranfield, near Bletchley, Bucks., have taken over the manufacture of the components previously made by the **Igranic Electric Company, Limited.** These include both 70° and 90° time-base components, deflection and focus coil assemblies for projection television and the complete range of Igranic wire-wound components. J. A. Field, who was in charge of the research and development section of Igranic's components division, has been appointed chief engineer of Dagnall and Kendall, and J. White, who was also in the division, is sales manager.

Atkins, Robertson and Whiteford, Limited, of Glasgow and London, manufacturers of components and industrial electronic equipment, have moved to a new factory on the Thornliebank Industrial Estate, Glasgow. (Tel.: Giffnock 1031/2.) Harry L. Ranson, formerly with the Furzehill Group, has been appointed general sales manager of the company.

Andec Limited is the new name adopted by Avis and Baggs, Limited, who have moved to larger premises in Bennet Road, Reading, Berks. During its seven years the firm has specialized in the application of electronics to industrial processes. It also undertakes batch or long-run production of transformers and fractional horse power electric motors.

The sales and service departments of **Staar Electronics Limited,** of 39, New Oxford Street, London, W.C.1 (manufacturers of the automatic record-playing equipment developed by Usines Gustave Staar, of Brussels), are now at 86, Palmerston Road, Walthamstow, London, E.17. (Tel.: Larkswood 5441/2.)

OVERSEAS TRADE

For the **Damascus Fair** (September 1st to 30th) Pye are setting up a complete television broadcasting station as they did for the Baghdad Fair in 1954. They will have a stand on which will be featured export sound and television receivers using printed circuits. The television transmitter will operate on 625 lines in the U.K. channel 8. Seven other receiver manufacturers—Bush, Cossor, Ekco, Ferguson, G.E.C., Kolster-Brandes and Regentone—are putting on a combined demonstration under the auspices of the British Radio Equipment Manufacturers' Association in the British Pavilion.

Iran.—A £300,000 contract has been awarded to Marconi's by the National Iranian Oil Company for the installation of a complete v.h.f. multi-channel radio-telephone system along the route of their new 600-mile oil pipeline from Abadan to Teheran. The order calls for the supply of 84 multi-channel equipments (Type HM181), together with a considerable quantity of telephone carrier equipment (to be supplied by the Telephone Manufacturing Company) and diesel electric power plant. The majority of the stations along the route will be unattended.

The equipment for the multi-channel v.h.f. radio-telephone system along the 200-mile route of the Sui to Multan gas pipeline in **West Pakistan** is being jointly manufactured by Pye, Limited, and Ericsson's Telephones, Limited.

Radio links, over which consumer demands will be transmitted to the electricity authority's headquarters for the automatic control of load shedding, are being supplied to **New Zealand** by Automatic Telephone & Electric Company, Limited. A supervisory and remote control system manufactured by A. T. & E. will be used to operate control equipment at one of the sub-stations. A. T. & E. are also supplying repeater equipment for the 80-mile coaxial cable (supplied by B. I. Callender's Cables), which will link Auckland and Hamilton, N.Z. It will initially provide 240 telephone circuits, but provision is made for this to be increased four-fold.

Switzerland.—A Marconi ST201 radar trainer is being modified by International Aeradio, Limited, for use by the Swiss air force.

International Aeradio, Limited, are to install and operate equipment to provide a communal radio-telephone service for six of the major oil companies prospecting in **North Africa.** The two main base stations will be set up at Benina and Tripoli, through which messages will be passed to and from the various mobile units operating in Libya.

Solartron, of Thames Ditton, Surrey, announce that they intend to establish an **American** sales and servicing company in the near future; to hold stocks at Philadelphia, Cleveland and Los Angeles; and to make nation-wide servicing arrangements through suitable agents. They have a team of engineers already in the States with headquarters at Western Instruments, Inc., Burbank, near Los Angeles, California.

Plessey Incorporated has been formed, with offices at 41, East 42nd Street, New York City, to represent and control the interests of the Plessey Company in the **United States.** The company's Chicago office is being closed.

R.C.A. Great Britain, Ltd., announce that their **high-fidelity equipment** produced in this country is now being exported to twenty-eight countries, including the U.S.A.

Malaya.—Three Malayan public services—police, customs and fire brigade—are to be supplied with v.h.f. mobile radio equipment by A. T. & E. (Bridgnorth), Limited. All the 43 sets are standard six-channel 10-watt equipment (Type RL).

Pye radio-telephone equipment has been installed by their Belgian agents, Semobel, in a fleet of taxis in **Brussels,** stated to be the first permanent radio taxi service in the country.

NEW "WIRELESS WORLD" BOOKS

Correcting Television Picture Faults.—Some 150 end-of-tube photographs illustrating a wide variety of receiver defects are included in this 76-page book, by John Cura and Leonard Stanley. Other photographs illustrate the effects of many different kinds of interference. The text explains the nature of the defects and indicates what action should be taken to correct them. The explanations are written in simple form for the layman and are supplemented by more technical information printed in smaller type. The book costs 3s 6d (postage 3d).

Guide to Broadcasting Stations, 1956/57.—The present chaos in the medium-wave band is emphasized by a glance at the medium-wave section of the latest edition of this book, from which it will be seen that some 50 per cent of the broadcasting stations in Europe are operating on "pirated" frequencies. Some 700 European stations operating on long and medium waves and nearly 2,000 short-wave broadcasting stations of the world are listed, both in order of frequency and geographically. The operating details—frequency, wavelength and power—have been checked against measurements made at the B.B.C. Receiving Centre, Tatsfield, Surrey. Within its eighty pages the book, which costs 2s 6d (postage 4d), also includes operating details of Europe's v.h.f. broadcasting stations, which now total nearly 400, and 170 television transmitters.

Radio Valve Data.—The 5th edition of this well-known manual has been revised and enlarged and includes characteristics of some 2,500 valves, transistors, metal rectifiers and cathode-ray tubes. An important feature is the improved presentation of the base connections, which are now given in diagrammatic form with the electrode connections marked against the appropriate pins. Price 4s 6d (postage 7d).

These books are issued for *Wireless World* by our Publishers, Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

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National Radio Show

PREVIEW OF TECHNICAL EXHIBITS

WITH a preview for overseas visitors and invited guests on August 21st, the 23rd National Radio Show opens to the public at Earls Court on the 22nd.

A stand-to-stand survey of the technical exhibits, prepared from information provided by the exhibitors, is given in the following pages. For those attending the Show the report and the plan opposite should provide a useful guide to the stands. Although there are bound to be some last-minute introductions by manufacturers, it is hoped that for those unable to visit the exhibition this survey will give a useful overall picture, which will be supplemented by the review of this year's trends in sound and vision receivers to be included in our next issue.

The Show is first and foremost an exhibition of domestic sound and television receivers, components and ancillary equipment. Of the 117 exhibitors, some 85 are manufacturers and of this number about 40 are makers of domestic receivers. Television Avenue, which has been a feature of the Show for some years, is discontinued but to each stand both B.B.C. and I.T.A. television transmissions are being piped for demonstration purposes. Most of the demonstration rooms are being fed with the B.B.C. v.h.f. sound transmissions.

The sponsors of the Show, the Radio Industry Council, have again provided, with the assistance of colleges and manufacturers, a "careers" display. Among the exhibits included in the display are the electronic air speed timing equipment used for the record-breaking flight of the Fairey Delta, guided missile equipment, a computer which will do sums for visitors and a radar screen with a scanner on the roof which visitors can operate.

ALPHABETICAL LIST OF EXHIBITORS

	Stand
Acos	202
Aerialite	51
Airmec	212
Alba	61
Ambassador	43 (D23)*
Antiference	69
Argosy	219 (D26)
Army	302, 308
Assimil	307A
Avo	3
B.B.C.	301
Barclays Bank	118
Belling-Lee	49
Bernards	109
Bowmaker	208
Brimar	39
British Radio & Television	110
British Railways	114
Bulgin	26
Bush	17, 29
Channel	108
Collaro	21 (D3)
Cossor	57 (D35)
Cossor Instruments	206
Decca	58 (D30)
Defiant	35, 37
De La Rue	8
Domain	107
Dubilier	62
Dynatron	4
E.A.P.	215
E.A.R.	67
E.M.I.	16, 23 (D10, D11)
E.M.I. Institutes	307
Econasign	210
Ediswan-Siemens	19 (D5)
Ekco	24, 30 (D17)
Electrical & Radio Trading	112
English Electric	40 (D20)
Ever Ready	54

*Demonstration rooms and offices are prefixed with "D".

	Stand
Ferguson	12 (D12)
Ferranti	31, 68 (D1)
G.E.C.	53 (D34)
G.P.O.	304
Garrard	50
Goodmans	105 (D7)
H.M.V.	28 (D8)
Hart	209
Hobday	218
Hunt	25
I.T.A.	309, 310, 311
Invicta	65
J.B. Cabinets	115
J-Beam Aerials	1
K.B.	20
Keith Prowse	36
Kerry's	214
Labgear	203
Linguaphone	207
Lloyds Bank	217
McMichael	59
Marconiphone	23 (D9)
Masteradio	15
Midland Bank	101
Mullard	32 (D2, D32)
Multicore	10 (D15, D18)
Murphy	42 (D4)
National Provincial Bank	116
Navy	303
Nixa	5
Opperman	319
Pam	55 (D33)
Pamphonic	34
Peto Scott	14
Philco	22, 317 (D26A)
Philips	44, 45 (D28, D29)
Pilot	27

	Stand
Plessey	9 (D16)
Plus-a-Gram	216
Portogram	66
Practical Wireless	111
Price	306
Pye	13 (D6)
R.A.F.	312
R.C.A.	103 (D14)
R.G.D.	52 (D31)
R.S.G.B.	305
R.T.R.A.	201 (D24)
Regentone	60
Roberts	48
Rola Celestion	6 (D13)
S.T.C.	117
Simon	46
Slingsby	104
Sobell	33 (D22)
Spectone	316
Spencer-West	211
The Star	318
Stella	56
T.C.C.	64 (D27)
Tape Recorders	38
Taylor	106
Telequipment	63
Telerection	18
Thompson, Diamond & Butcher	70
Ultra	41
United Appeal for the Blind	314
Valradio	213
Vidor	11 (D25)
Waveforms	205
Westinghouse	102
Westminster Bank	113
Whiteley Electrical	47 (D19, D21)
Wireless & Electrical Trader	204
Wireless World and *Wireless Engineer*	7
Wolsey	2
Wood & Metal Industries	315

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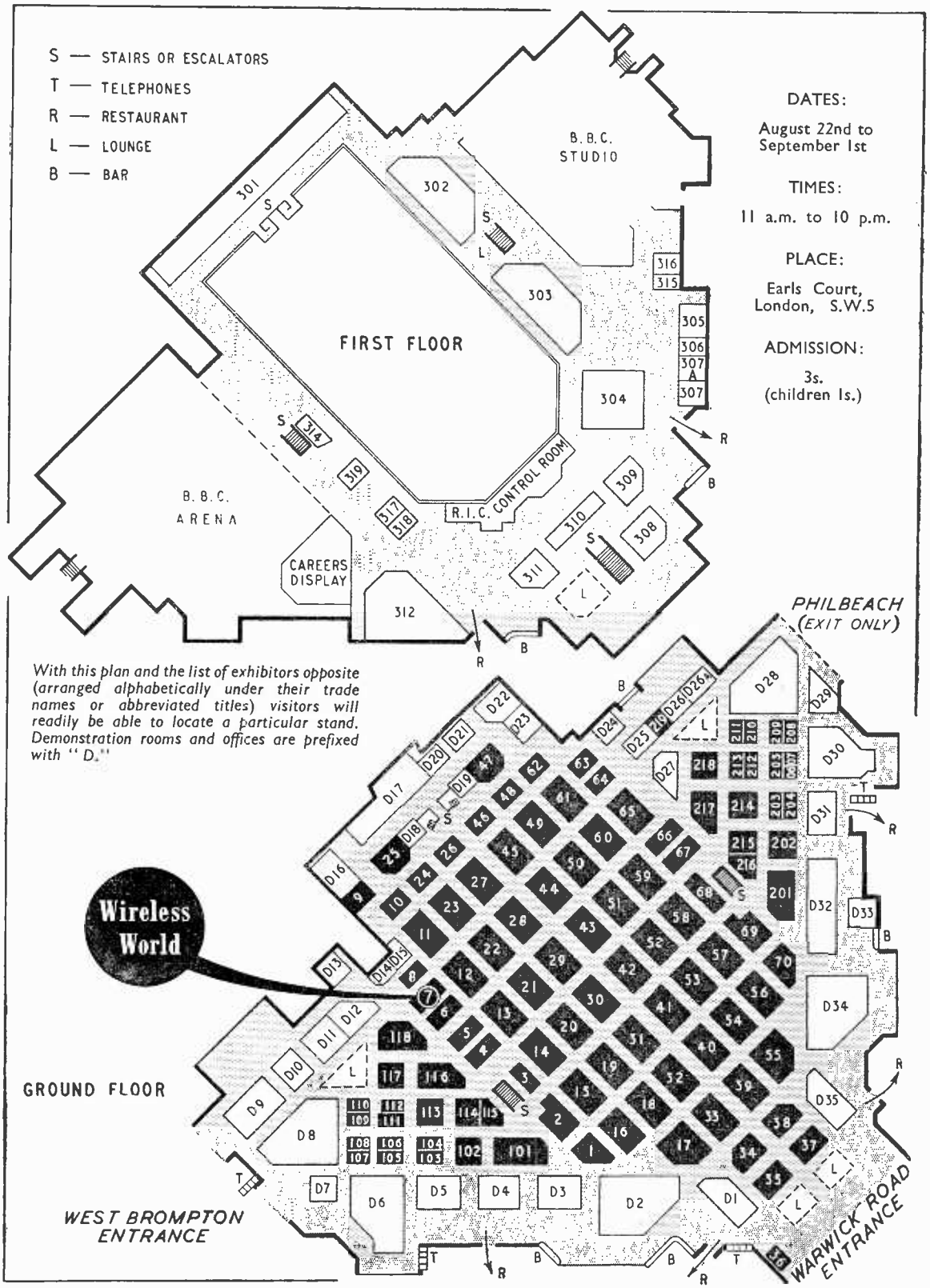

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NATIONAL RADIO SHOW

Guide to the Stands

ACOS (202)

Pickup replacement cartridges designed to give accurate groove tracing at high lateral accelerations ("Hi-g") are available to fit most record players and changers with removable heads. For use in extreme tropical conditions, a turnover head with ceramic pickup element (GP61-1) is now being produced.

The exhibit will include a range of piezo-electric microphones ranging from the inexpensive MIC35 to the MIC16 sound-cell type for studio use.

Cosmocord Ltd., Eleanor Cross Road, Waltham Cross, Herts.

AERIALITE (51)

Wide spacing of elements in Band III aerials is advocated by Aerialite as a means of obtaining a wide bandwidth and less disturbance of characteristics in proximity to buildings. Models are shown with up to 11 elements.

Additions to the range of twin-band aerials include two new "Unilead" models, so called because the interconnection between the two systems is effected in the factory and only a single downlead has to be fitted on erection.

Three Band III convertors are now available: Model TC2 gives a single channel only; TCD, giving two channels at high sensitivity, has an r.f. stage, and MC continuous coverage. All three have Band I/Band III switching.

Aerialite, Ltd., Castle Works, Stalybridge, Cheshire

AIRMEC (212)

Two interesting test equipments, one for servicing television sets and the other for sound receivers are to be shown this year. The former is the Televet Type 877 and is complete self-contained portable test room comprising pattern generator. oscilloscope, wobbulator, a.m. signal generator, a.f. oscillator and valve voltmeter.

The other is for a.m. and f.m. receiver testing and again is a self-contained and comprehensive item of equipment. It embodies a signal generator covering 100 kc/s to 15 Mc/s and 85 to 100 Mc/s, an oscilloscope, wobbulator and an a.f. oscillator. Both are mains operated.

Airmec, Ltd., High Wycombe, Bucks.

ALBA (61)

Separate sensitivity controls on Bands I and II enable programmes to be switched rapidly in the new T641 and T644 table model television receivers, which have 14-in and 17-in tubes respectively. Both models are fully screened against radiation. Two 17-in and two 21-in consoles, complete the television range.

There is a choice of four table-model sound broadcast receivers, six radio-gramophones and two portable record reproducers among which the Model 202 a.c./d.c./battery portable, Model C116 midget receiver, and Models 880 and 881 record reproducers are new.

A. J. Balcombe, Ltd., 52-58, Tabernacle Street, London, E.C.2.

AMBASSADOR (43)

Television receivers with 17-in and 21-in tubes are to be shown. They have turret tuning and vision-channel a.g.c. The 17-in is available as a table model, but the 21-in is in console form. The console form of the 17-in is unusual in being roughly triangular in plan so that it will fit closely into the corner of a room.

A sound broadcast receiver covers the medium- and long-wave a.m. bands and the f.m. band, for which there is a built-in v.h.f. dipole aerial.

Ambassador Radio & Television Ltd., Princess Works, Brighouse, Yorks.

ANTIFERENCE (69)

The "Hil-O" range of dual-band television aerials is based on what is described as "electronic coupling"; the Band III signal is transferred to the feeder only by the proximity of the Band III dipole to the Band I element. The range has been extended and now includes no fewer than 17 different models.

A new one-piece coaxial plug has been introduced which simplifies the fitting of the cables. No loose outer grip is employed, the cable being firmly gripped by squeezing the sides of the body of the plug on to the woven copper sheath of the cable. The centre conductor is soldered in place. The plug is fully insulated by means of a Neoprene sheath.

Antiference Ltd., Bicester Road, Aylesbury, Bucks.

ARGOSY (219)

Radiograms equipped for v.h.f. reception and with 4-speed record players are among the completely new ranges of domestic equipment to be shown this year. Television receivers designed for long-range reception will be featured, and also automatic record players with the latest 4-speed motors. In external design of cabinets the "contemporary" style will be predominant.

Argosy Radiovision, Ltd., Abbey Road, Barking, Essex.

ARMY (302, 308)

A feature of the Army's exhibit, which is manned by the Royal Corps of Signals, is a demonstration of the complete cycle of training in a trade in the Corps. Examples of ancient and modern radio equipment are compared and the Army's present-day communications system is traced through division and brigade H.Q. installations down to the latest "walkie-talkie" equipment.

The War Office, Whitehall, London, S.W.1.

ASSIMIL (307A)

A system of language instruction by gramophone records is offered by this firm, who have a preliminary course of eight double-sided 78-r.p.m. records, including text-book and tuition service, and an advanced course consisting of a further 12 records and tuition. The complete range of courses in Russian, French, German, Italian, Spanish and Dutch will be available for private listening on the stand.

E.M.I. Institutes, Ltd., 10, Pembridge Square, London, W.2.

AVO (3)

Some items of test equipment hitherto shown as prototypes are now available as production models; these include the two signal generators covering Bands I, II and III. "Mark III" covers 150 kc/s to 220 Mc/s with internal amplitude modulation. The other is the "Wide Band AM/FM Signal Generator" providing amplitude modulation from 5 to 225 Mc/s and f.m. from 60 to 120 Mc/s with deviation up to ±150 kc/s. Provision is made for checking the frequency and adjusting the scale cursor when necessary.

Another interesting Avo instrument is the "Universal Measuring Bridge Type 1" for resistance, capacitance and inductance measurements. In addition there is a full range of the well-known Avometers.

Automatic Coil Winder and Electrical Equipment Co. Ltd., Douglas Street, London, S.W.1.

B.B.C. (301)

Continuing the campaign to popularize v.h.f. sound broadcasting, the B.B.C.'s stand includes a demonstration theatre where visitors can compare direct reception of a programme on v.h.f., on medium or

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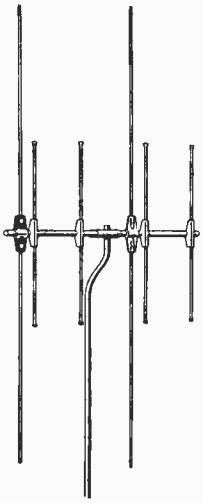


Antiference HL402/4K combined television aerial utilizing the "electronic coupling" principle.

long waves or by line from Broadcasting House.

Among various methods of instruction devised by the Engineering Training Department which can be seen on the stand are demonstrations showing the operation of the cathode follower and the diode detector and experiments in geometric optics. An automatic monitor for checking transmitter performance shows the type of equipment being installed by the Corporation to eliminate uninteresting routine jobs.

British Broadcasting Corporation, Broadcasting House, London, W.1.

BELLING-LEE (49)

Although aerials are to be the prominent feature of this firm's display, Belling-Lee produce also a wide range of small parts such as fuses, terminals, thermal-operated switches, valveholders and a variety of plug and socket connectors.

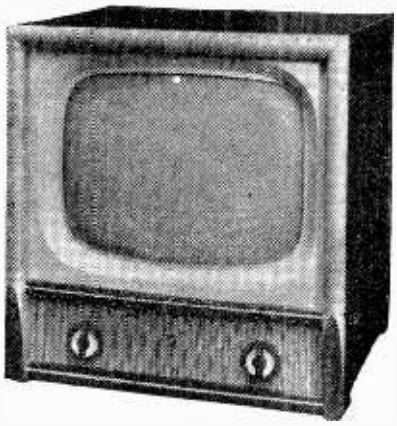
The latest developments in aerials are the collapsible Band III models designed for more convenient transport but just as effective in use as the factory assembled models. Combined Band I/Band III aerials cover a very wide range, from a simple "Loftrod" (indoor type) to an "H" with two 6-element Band III Yagis arranged to form a broadside array. This type of fringe-area aerial is suitable for use where both B.B.C. and I.T.A. stations are co-sited. For use elsewhere separately orientated systems are available.

Aerial accessories shown include cable outlet sockets, aerial amplifiers, Band I/Band III filters and a comprehensive range of interference suppressors.

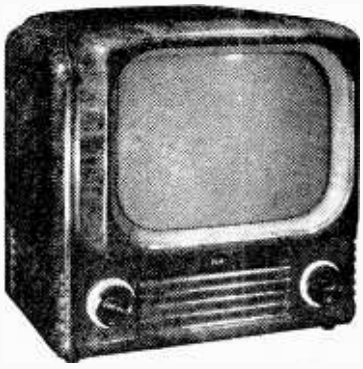
Belling and Lee, Ltd., Great Cambridge Road, Enfield, Middlesex.

BRIMAR (39)

A reasonable size of television set cabinet, combined with a big picture,



Alba Model T644.



Bush TV 62 with 14-in tube in Bakelite cabinet.

Acos ceramic pickup cartridge (GP61)

is made possible by the new C21KM 21-in c.r. tube to be shown, which has a 90° deflection angle. A range of valves suitable for the time bases of such 90° tubes will also be seen.

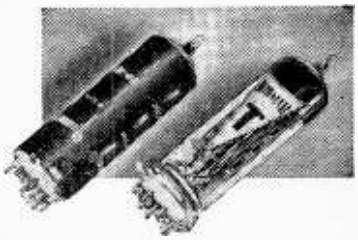
Among the special-quality valves will be flying-lead types assembled with close-fitting cooling cans and mounted on nylon-loaded PTFE bases.

Transistors will include the comparatively new TS series (*p.n.p.* junction types) which are approximately half the size of their predecessors (TP and TJ series) and are hermetically sealed in metal cans.

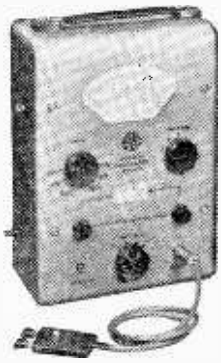
Standard Telephones and Cables Ltd. Footscray, Sidcup, Kent.

BULGIN (26)

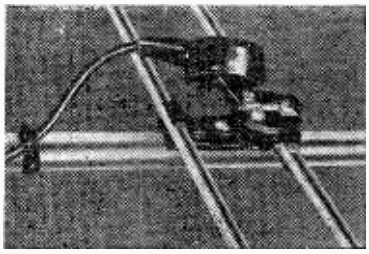
This firm specialize in the manufacture of signal lamps, switches, knobs, connectors and a host of small, but important, parts used in the radio and electronic industries.



Brimar mounted flying-lead valves.



Avo signal generator Type III covering 150 kc/s to 220 Mc/s.



New style centre insulator fitted to Belling-Lee Band III aerials.

New items shown this year include a pillar-type signal lamp, rather like a lighthouse with a 30° side window and with or without a transparent top. There is also an inexpensive type of key switch available in several styles, such as locking both sides or locking one side and spring-loaded the other, or spring-loaded both sides. Various contact combinations are available.

A toggle-action micro-switch and an ultra-lightweight version of the Lilliputian model shown last year, but operating with under 5 oz pressure, are also new.

A. F. Bulgin and Co. Ltd., By-Pass Road, Barking, Essex.

BUSH (17, 29)

Television receivers manufactured by this firm retain the form of station-selector mechanism introduced last year. Tuning is by a method which gives basically con-

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tinuous tuning in each band but which is operated by a control moving it in steps and so giving the effect of a switch selector. The 14-in tube model is available in two styles of table cabinet, one of moulded Bakelite and the other of wood, and there is a larger type with a 17-in tube which is basically the same electrically.

Among the sound receivers the models including a v.h.f. band now outnumber the purely a.m. sets. The VHF 90, for example, has a double-triode for the v.h.f. "front-end." It is a two-band set covering v.h.f. and medium waves and it has a built-in dipole for v.h.f. and a ferrite-rod aerial for medium waves. Provision is made for the use of an external v.h.f. aerial.

Bush Radio Ltd., Power Road, London, W.4.

CHANNEL (108)

New equipment shown this year includes two general-purpose power supply units. One, the Type PS12, gives a stabilized output variable from 200 to 400 V d.c. and an unstabilized d.c. output of 550 V with an output impedance of less than one ohm. There is also an improved version of the Type T3 pattern generator which covers both television bands.

Channel Electronic Industries Ltd., Dunstan Road, Burnham-on-Sea, Somerset.

COLLARO (21)

Four-speed turntable drives (including 16⅔-r.p.m.) are now available in three new gramophone units—the AC4/564 single-record player, RC456 record changer and 4T-200 transcription unit. All these units are fitted with the "Studio" crystal pickup cartridge and the record changer can be switched to be operated manually for single discs.

A pre-amplifier and power pack are now available for use with the "Tape Transcriptor" magnetic recording mechanism. This employs four heads and both top and bottom tracks can be recorded and played back without changing over spools. Tape speeds of 3¾, 7½ and 15in/sec can be used according to the frequency range required for the material to be recorded.

Collaro Ltd., By-Pass Road, Barking, Essex.

COSSOR (57)

Outstanding in the new range of television sets on show will be a 21-in table receiver, model 947. With a chassis layout and cabinet designed to facilitate easy servicing, it has 15 valves, an aluminized tube, self-centring flywheel sync and automatic contrast control. Ease of servicing is also a feature of the 17-in model 942 console receiver, in which the screen safety glass can be easily detached for cleaning the tube face. Another 17-in console (with full-length cabinet doors) will be on view, also a low-cost 14-in table set for areas of good signal strength, together with a long-range version, and finally a 17-in table receiver.

A v.h.f. waveband is included in the latest addition to the well-known range of "Melody Maker" sound broadcast receivers and also in the new model 529 radiogram, which has three speakers with a crossover network.

Printed circuit technique will be seen in the new "Melody Portable," which is a 4-valve battery superhet for long and medium waves with a ferrite rod aerial and a 5-in loudspeaker. With the batteries it weighs 6lb.

A. C. Cossor Ltd., Cossor House, Highbury Grove, London, N.5.

COSSOR INSTRUMENTS (206)

Construction kits for two instruments—the first of a series—will be introduced this year, one being a valve voltmeter and the other an oscilloscope. Also on show will be the model 1322 "Telecheck" and marker generator for Bands I and III—a frequency-modulated alignment oscillator with internal crystal-controlled frequency markers. In addition, there will be a Band-III convertor for extending the frequency range of an earlier "Telecheck" and an f.m. receiver alignment generator having a carrier frequency generator modulated by the sawtooth waveform of the display c.r.o. to provide the sweep. The display will be completed by a range of oscilloscopes and c.r. tubes.

Cossor Instruments Ltd., Cossor House, Highbury Grove, London, N.5.

DECCA (58)

Choice of seven television receivers is offered with tube sizes ranging from 14 to 21in. The recently introduced table model DM4 (17in) and its console version DM4/C are fitted with tambour (folding) doors to cover the tube face when not in use. Models DM4/C, DMC/D18 and DMC/D21 incorporate a sound broadcast receiver for the v.h.f. service with switched selection of alternative programmes. Model 444 provides television, v.h.f., short, medium and long wave reception and includes a three-speed record changer.

There are three radio-gramophones with four-waveband receivers (including v.h.f) and combined moving-coil and electrostatic loudspeaker systems in each case.

The "Panatrope" console record reproducer, "Portrola" portable radio-gramophone and "Deccalian" and "Deccamatic II" portable gramophones are continued.

Decca Record Co. Ltd., 1-3, Brixton Road, London, S.W.9.

DEFIANT (35, 37)

Television receivers with 14-in, 17-in and 21-in tubes are being shown. Turret tuners are used and flywheel sync is provided. Sound receivers include models covering the v.h.f. band as well as the long, medium and short wavebands.

There is also a portable record reproducer which includes a 4-speed automatic record changer.

Co-operative Wholesale Society Ltd., 1, Balloon Street, Manchester.

DE LA RUE (8)

The "Delaron" division of this firm is represented by a wide variety of laminated plastics including Delaron Copper Clad for printed (etched) circuits. A recent development is Delaron Neoprene Clad in which the synthetic rubber functions as a seal for the ends of electrolytic capacitors.

Thomas De La Rue and Co. Ltd., 84-86, Regent Street, London, W.1.

DOMAIN (107)

This stand is devoted to a display of tables for television sets and trolleys for apparatus, such as oscilloscopes.

Domain Products Ltd., Barnby Street, London, N.W.1.

DUBILIER (62)

This firm caters for the diversified requirements of the radio industry in respect to capacitors, resistors and volume controls of one kind or another. Among their latest additions are some sub-miniature electrolytic capacitors, plastic film dielectric tubular capacitors, encapsulated pulse-forming networks and a small 7-ampere choke for suppressing electrical equipment causing interference to television. This last item is an addition to the existing range of television and other types of suppressors produced for use with domestic electrical appliances.

Capacitors, resistors and volume controls are being produced with special terminations and connections for use in printed circuits.

Dubilier Condenser Co. (1925) Ltd., Ducon Works, Victoria Road, North Acton, London, W.3.

DYNATRON (4)

A pre-tuned switch-controlled v.h.f. tuner is to be exhibited in which a.f.c. is employed and provides four channels with an output at audio. Save for the audio side, it is virtually a complete receiver and it forms the heart of the RG10 radio-gramophone. Here it is accompanied by an a.f. amplifier and a tone-control unit and a bass-reflex loudspeaker.

Television sets have 17-in or 21-in tubes. The latter has provision for f.m. sound reception.

Dynatron Radio Ltd., The Firs, Castle Hill, Maidenhead, Berks.

E.A.P. (215)

The new "Elizabethan de luxe" tape recorder incorporates the Collaro "Transcriptor" and has facilities for mixing microphone and gramophone

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inputs, headphone monitoring and a voltage output for feeding an external amplifier. The internal amplifier is rated at 3½ watts and the loudspeaker is a 9in × 5in elliptical type.

The "Elizabethan" portable recorded has been redesigned and will be known as the "Elizabethan—56."

E.A.P. (Tape Recorders) Ltd., 9, Field Place, St. John Street, London, E.C.1.

E.A.R. (67)

Electric gramophones include the "1960" range with both portable and "Chairside" versions, the latter designed to serve also as a table for a television or sound broadcast receiver. A transistor portable gramophone will also be shown.

A new series of amplifiers with outputs from 4 watts includes the "Three-Nine-Five" for which the distortion at 20 watts is rated at 0.05 per cent.

Electric Audio Reproducers Ltd., The Square, Isleworth, Middlesex.

E.M.I. (16, 23)

Tape records of the "Stereosonic" kind will be seen amongst the comprehensive display of records from all the E.M.I. group on stand 16. Here there will also be a technical bureau with staff to answer questions about sound recording and reproduction.

Professional tape recording equipment to be shown on stand 23 will include a new and versatile recorder, the TR90, which is available in three versions—in two carrying cases, in rack-mounted chassis and in a glass-topped console. The latest 8¼in spools, giving increased recording capacity, will be seen in the new TR51 transportable machine. An accessory pack for tape jointing (including leader strips) will also be displayed.

Electric and Musical Industries Ltd., Hayes, Middlesex.

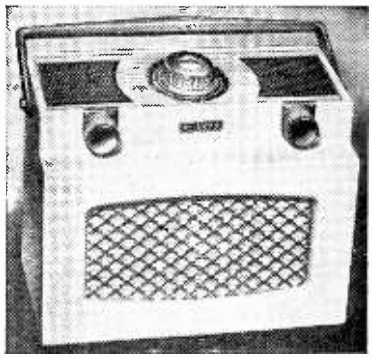
E.M.I. INSTITUTES (307)

A method of practical training by post in radio and electronics is provided by this institute, which is part of the well-known industrial organization. On display will be examples of the equipment which the student builds and studies at home alongside the theoretical instruction. Facilities will be available for private interviews.

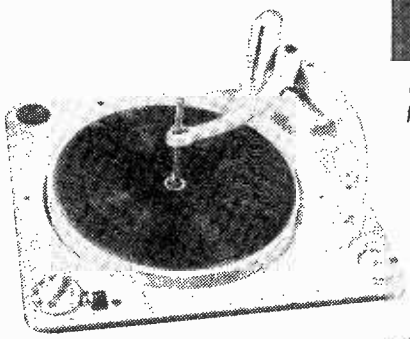
E.M.I. Institutes, Grove Park Road, London, W.4.

EDISWAN-SIEMENS (19)

Two double-cone loudspeakers, 10in and 12in, with built-in mechanical cross-over networks will be among the new exhibits on this stand. Asso-



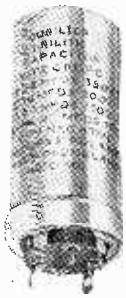
Cossor "Melody Portable" with printed circuit.



Collaro four-speed record changer (RC456)

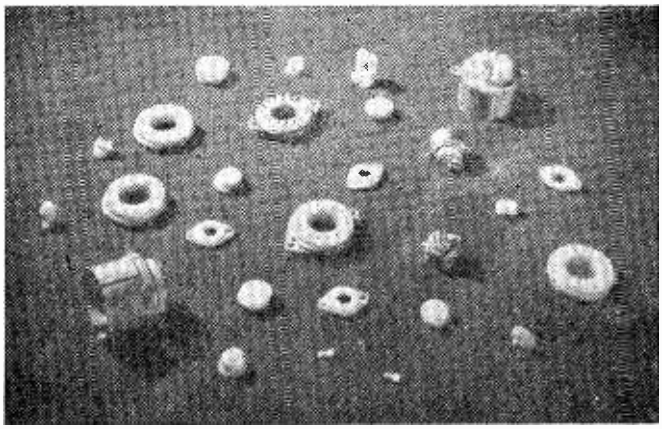
E.A.R. "1960" portable gramophone.

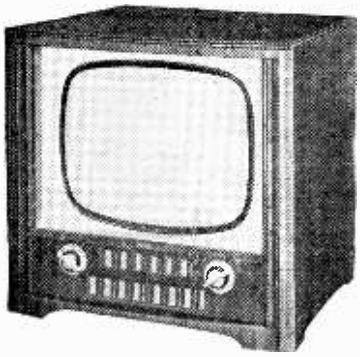
E.A.P. "Elizabethan de Luxe" recorder.



Dubilier triple unit "Drilitic" capacitor, Type CRE/PC, for printed circuits.

Ediswan Clix radio components manufactured from fluorocarbons.





Decca DM4 television receiver.

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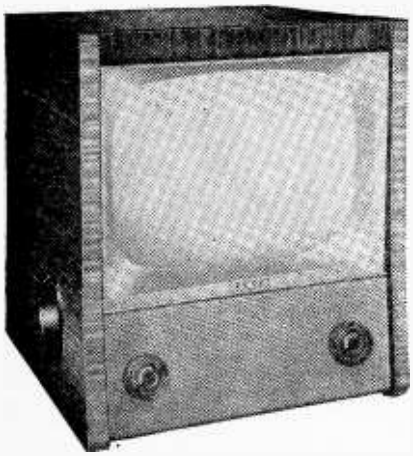
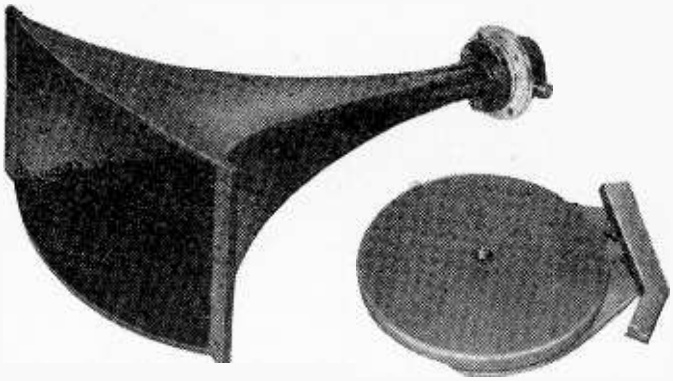


Ekco model T284 with 17-in tube.



Goodmans "Midax" mid-frequency unit.

Garrard BAI battery record player.

ciated amplifiers will also be shown. Other electronic apparatus will include marine radio equipment.

Valves for f.m. and Band-III television will be displayed and c.r. tubes will include a new 24-in rectangular type. Industrial valves will be represented by a new vapour-cooled type ESV.1002, while at the other end of the size scale will be miniature diodes for electronic instruments.

Clix radio components will be on view and also an extensive display of high-performance fluorocarbon resins and components incorporating PTFE.

The Edison Swan Electric Co. Ltd., 155, Charing Cross Road, London, W.C.2.

EKCO (24, 30)

Among the television receivers to be shown by this firm are new 14-in and 17-in tube models, the T283 and T284. They have turret tuning and flywheel sync, automatic bandwidth control and automatic interference inverter. They are both table models. The T293 is similar to the T284, but has provision for the reception of Band II f.m. sound transmissions.

Sound receivers covering the v.h.f. band only are made and the new types include the A277 table model and the C273 console. A double-triode frequency-changer is used and there are two i.f. stages feeding a ratio detector. Two loudspeakers are used and provision is made for connecting a tape recorder and for using a record player.

E. K. Cole Ltd., Ekco Works, Southend-on-Sea, Essex.

ENGLISH ELECTRIC (40)

Television receivers with 17-in and 21-in tubes are being exhibited. They are available in two forms, with and without provision for f.m. sound reception on Band II, the price difference being of the order of £5. All models cover Bands I and III.

English Electric activities in other fields are illustrated by photographs and models.

The English Electric Co. Ltd., Marconi House, Strand, London, W.C.2.

EVER-READY (54)

The weights of the two new battery portables to be shown by this firm, "Sky Princess" and "Sky Baby," are only 6½lb and 6¾lb respectively. They are 4-valve superhets using low-consumption valves, and are designed in flat carrying cases with hinged lids on the "personal" principle. The "Sky King" is another new battery set of larger and more conventional design. All have high sensitivity speakers and long and medium wavebands.

Among export receivers a new and improved version of the "Saucepan Special" will be shown. A stout metal cabinet is used and the components of the 4-valve superhet circuit are tropicalized.

A subsidiary company, Berec Radio, Ltd., will also be exhibiting a complete range of portable receivers, the "Calypso," "Ballerina" and "Jester" being solely battery sets while the "Fiesta" is a mains/battery model. Ferrite rod aerials are used in all but the "Jester."

As usual there will be a comprehensive display of dry batteries, including the compact layer types.

The Ever Ready Co. (Great Britain) Ltd., Hercules Place, London, N.7.

FERGUSON (12)

A range of television sets, sound receivers and radio-gramophones is to be shown on this stand. Sound receivers include types covering the v.h.f. band as well as medium and long waves, and this applies also to the radio-gramophones.

New television models have 17-in and 21-in tubes. Among the latter is a table model, the 308T.

Thorn Electrical Industries Ltd., 105-109, Judd Street, London, W.C.1.

FERRANTI (31, 68)

This firm has now introduced v.h.f. reception into its radiograms. Three models will be shown: the 6-valve 355 with a 10-in speaker, the 8-valve 455 with push-pull output into twin 8-in speakers and the 12-valve 1055 with a short-wave band, separate bass and treble controls, and a push-pull output handled by 7-in and 12-in speakers. All models have three-speed record changers.

In television the latest introduction is a 20-in table projection receiver, model 20T6, which incorporates a paraphase video circuit to permit a large contrast range. There will also be a 24-in console projection receiver and, in direct-viewing sets, 14-in, 17-in and 21-in models.

Among the valves and cathode-ray tubes an outstanding exhibit will be a range of silicon power rectifiers. These are hermetically sealed junction types with very low reverse currents and an ability to work at high temperatures.

Ferranti Ltd., Hollinwood, Lancs.

G.E.C. (53)

To meet the requirements of extreme fringe areas, a complete range of 14-in and 17-in television receivers fitted with flywheel sync will be shown. For those who prefer larger pictures there will be a new 21-in table model and a 21-in console model. A range of Band-III convertors for use with earlier G.E.C. receivers will also be displayed.

In sound broadcast receivers there will be two new table models covering the v.h.f. transmissions, while three radiograms having the same facility will be exhibited.

The display of valves and c.r. tubes will include a new audio output beam pentode, KT88, xenon-filled rectifiers, silicon junction rectifiers, industrial c.r. tubes and valves for r.f. heating and radar. A model of a 2-W transistor a.f. amplifier will be shown, and demonstrations will be given (in room D34) of high-quality sound reproduction equipment.

The General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2.

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G.P.O. (304)

A speech synthesizer developed as part of a programme of research into ways of transmitting speech more economically is being demonstrated. It consists of a pulse generator of variable repetition rate to represent the voice excitation, a random noise hiss generator, and three adjustable electrical resonant circuits to impose the "formant" frequencies on the spectrum of the combined output of these two sources. For demonstration purposes a special control unit is being used so that simple words can be produced.

Other exhibits include an electronic sorter, electronic telephone switching, the prototype of the latest quartz-crystal controlled speaking clock and ERNIE, the Premium Bond "wheel of fortune," described on page 440.

General Post Office, St. Martins-le-Grand, London, E.C.1.

GARRARD (50)

A new "transcription" pickup arm with many adjustments not normally provided, and a 45-r.p.m. battery-operated turntable (BA1) for use in miniature valve or transistor portable gramophones are likely to be centres of interest on this stand. The backbone of the exhibit will, as in previous years, be the range of multi-speed gramophone turntables and record changers which includes the RC120/4 and RC121/4 which are designed to occupy the minimum of cabinet space.

Pickup heads include a ceramic type (GCE4) and a moving coil of new design. The Garrard stylus pressure gauge has been redesigned and now includes a spirit level for checking the turntable.

Garrard Engineering and Manufacturing Co. Ltd., Swindon, Wilts.

GOODMANS (105)

The introduction of "pressure" units into the range of loudspeakers designed for high-quality reproduction is a new departure for Goodmans. In the "Midax" unit covering middle frequencies the horn is of rectangular section and the recommended cross-over frequencies are 750 c/s and 6 kc/s. The "Trebax" unit covers 5 kc/s to 16 kc/s and has a short built-in horn. Cross-over filters are available for coupling the two pressure units and for adding a low-frequency direct radiator cone unit for frequencies below 750 c/s.

A new cabinet ("Viscount") designed for use with the majority of Goodmans cone loudspeakers includes the recently developed acoustical resistance unit.

Goodmans Industries Ltd., Axiom Works, Wembley.

H.M.V. (28)

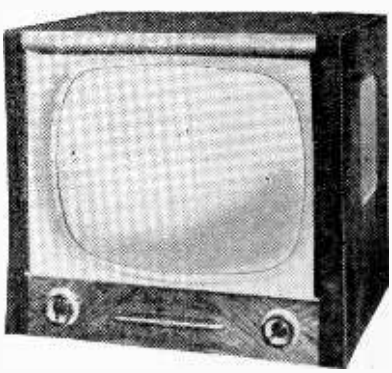
A new range of tape record reproducers to be shown by this firm include the 3031 table model with pre-amplifier and equalizer, giving an output suitable for high quality amplifiers, and the 3032, a console version with tape storage space. Model 3033 is a complete reproducer incorporating a 10-watt amplifier and a dual speaker system, while Model 3034 is for playing "Stereosonic" dual-channel tapes. Model 3035 is a stereophonic tape deck.

Six speaker units, including an electrostatic ribbon type, cover the a.f. ranges in the 3052 high quality disc reproducer to be shown. The 18-watt amplifier has a response of 20 c/s to 30 kc/s. The associated pre-amplifier, incorporating tone control, equalization, etc., is a separate unit with remote control.

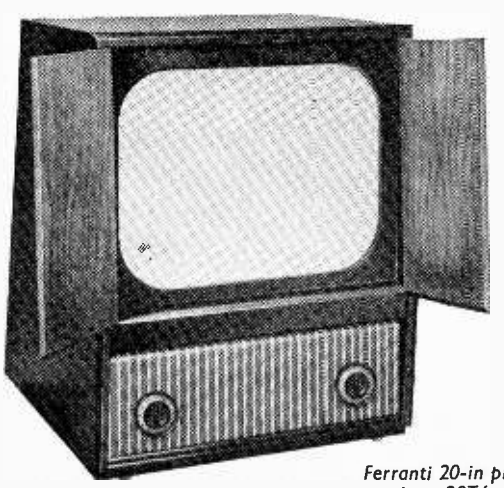
New radiograms incorporating v.h.f. reception will be exhibited, one having an ultra-linear amplifier and four speaker units in an acoustically loaded enclosure.

To compensate automatically for

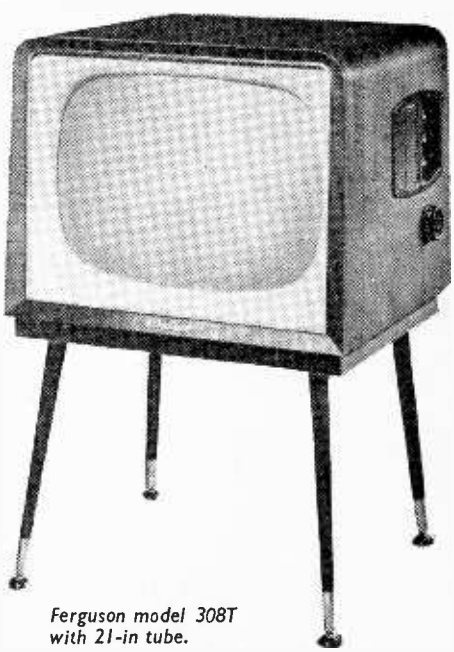
Berec "Ballerina" portable receiver.



G.E.C. 21-inch receiver, BT3251.



Ferranti 20-in projection receiver, 20T6.



Ferguson model 308T with 21-in tube.

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differences in strength between Band-I and Band-III signals a new 21-in television receiver incorporates an improved vision a.g.c. system. The sound receiver has a dual speaker system comprising a 10½-in bass unit, which can be moved to either side of the cabinet, and a front-facing tweeter. Table (1847) and console (1848) versions will be on show.

The Gramophone Co. Ltd., Blyth Road, Hayes, Middx.

HART (209)

Several additions have been made to the range of radio cabinets in which this firm specialize. A novel design is the "Hartique Stayrite" television table which can be erected or dismantled in a few seconds. The top when assembled measures 23× 21in and it is 23in high; castors are fitted.

Alfred Hart and Co. Ltd., 243-249, Upper Street, Highbury Corner, Islington, London, N.1.

HUNT (25)

The manufacture of fixed capacitors of all kinds for the radio and electronics industries comprises the main activity of this firm. Their products include paper, ceramic and synthetic film dielectric varieties, as well as types designed for use in printed circuits.

Among the latest additions is a range of "Duolectric Supermoldseal" capacitors, so called because they are constructed of metallized paper with synthetic film interleave and encapsulated by a cast resin technique providing a tough, heat- and water-resisting casing which withstands temperature changes of from −40°C to +100°C. This form of encapsulation is used for several other ranges.

A. H. Hunt (Capacitors) Ltd., Bendon Valley, Garratt Lane, Wandsworth, London, S.W.18.

I.T.A. (309, 310, 311)

This is the first time that the sponsors of the alternative television service have participated in the Radio Show. The I.T.A.'s stand, which is shared with the two London programme contractors—Associated Rediffusion and Associated Television, naturally stresses the growth of the alternative service in its first year. Part of the stand is devoted to a "conversion centre" where members of the Radio and Television Retailers' Association give advice to viewers on the conversion of their sets.

Independent Television Authority, 14, Princes Gate, London, S.W.7.

INVICTA (65)

Two radiograms incorporating v.h.f. reception will be exhibited on this stand—the Model 59 console with a 3-speed automatic record changer and the Model 60, incorporating the latest type of 4-speed record changer. V.H.F. is also obtainable on the 6-valve sound broadcast receiver, Model 38. Notable for their light weight of under 7lb will be two portable sets, the all-battery Model 26 and mains/battery, Model 27.

Television receivers to be shown will include a 14-in and two 17-in table models, two 17-in consoles and a 21-in console.

Invicta Radio Ltd., 100, Gt. Portland Street, London, W.1.

J. B. CABINETS (115)

This firm specialise in the production of radio, radiogram and television cabinets for the trade. An interesting feature of their display is a selection of cabinets made especially for the American market.

J. B. Manufacturing Co. (Cabinets) Ltd., Howard Way, Harlow, Essex.

J-BEAM AERIALS (1)

Pioneers of the skeleton-slot aerial, J-Beam has now introduced a skeleton-horn aerial for Band III, which, combined with a vertical dipole for Band I, has been named the "Hornbeam." Two models are made, one with reflector and one without. The Band III gain, relative to a dipole, is 7 to 9 dB and the bandwidth 170 to 230 Mc/s.

A wide range of individual Band I and Band III aerials, the latter embodying skeleton slots in multi-element systems, is also to be shown.

J-Beam Aerials Ltd., Westonia, Weston Favell, Northampton.

K.B. (20)

A newcomer to the range of sound receivers is the NR30, which covers medium and long waves as well as the v.h.f. band, with internal aerials. Three loudspeakers are included to improve the sound distribution.

Among the existing models which are being continued is the FB10FM, an f.m. receiver which can also be used as an f.m. adaptor with existing a.m. receivers.

Television sets have pictures in the three standard sizes of 14-in, 17-in and 21-in. All models have turret tuners and a form of automatic gain control.

Kolster-Brandes Ltd., Footscray, Kent.

LABGEAR (203)

Two new indoor television aerials make their appearance this year. One is a dual-band type consisting of a Band III dipole with a compressed Band I aerial wound spirally around it. The centre insulator is common to both systems and can be plugged directly into the aerial socket on the television set. Alternatively it can be mounted elsewhere and a 75-ohm feeder used. This is known as the "Spiral" aerial.

The other indoor aerial is for Band I only and is intended for erecting in the loft. Described as the "Bi-Square" it is said to give a good performance up to 40 or 50 miles. The "Spiral" is for use at about 10 miles.

Aerial interference suppressors and cross-over filters are shown also.

Labgear (Cambridge) Ltd., Willow Place, Cambridge.

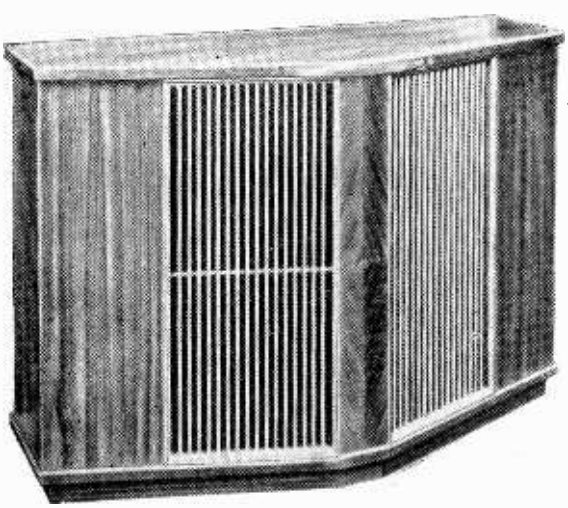
LINGUAPHONE (207)

Courses of instruction in foreign languages through the medium of gramophone records and books are offered by this company. Altogether 32 courses are available, the most recent additions being in South-American Spanish and Icelandic.

Linguaphone Institute Ltd., 207-209, Regent Street, London, W.1.

McMICHAEL (59)

Several of the new television sets now embody a "black spotter," a circuit feature which blanks out the white spots on the screen produced by severe ignition and similar inter-



H.M.V. 3052 reproducer with six loudspeakers and amplifier.

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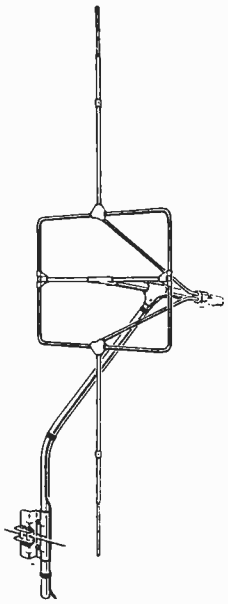
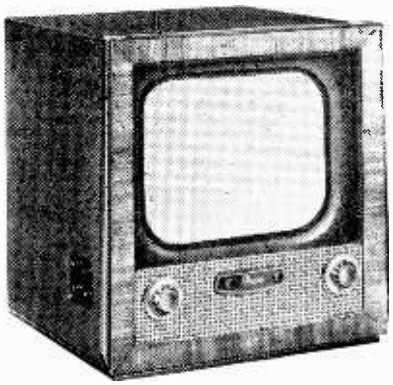
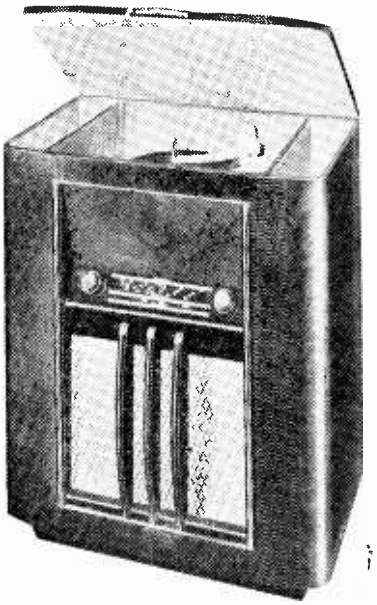


J-Beam "Hornbeam I" dual-band aerial.



Marconiphone 14-in receiver, VT150.

Hunt "Duolectric Supermoldseal" capacitors for 750V and 1,000V d.c. working.



Invicta 60 radiogram with 4-speed record changer.

ference. This is generally far worse in fringe areas. The new sets offer the choice of 14, 17 and 21-in tubes and multi-channel tuners.

A 3-waveband a.m./f.m. chassis is included in the Model C417FM combined television and broadcast receiver. It has provision for a gramophone input and extension loudspeakers.

The majority of the new sound only sets have an f.m. range and built-in aerials for all bands are common, but there is provision for external aerials. One radiogram, M101RG, actually has push-button station selection operative on f.m. and a 4-speed automatic record changer.

McMichael Radio Ltd., Slough, Bucks.

MARCONIPHONE (23)

Electrostatic focusing is used in the 14-in c.r. tube of the new VT150 table television receiver to be shown, and is claimed to give an exceptionally sharp picture with accurate focusing over the whole screen. High sensitivity circuits are used, with extra gain on Band III channels. Another new set, model VC152, has the large screen size of 21in and has special circuit features to counteract fading, aircraft flutter and variations in signal strength between Band I and Band III stations.

Among radiograms the new "Studio" model, ARG49A, is notable for its modern styling and low-level cabinet with a Warerite table top. It has a 6-valve a.m./f.m. circuit with a 3-speed automatic record changer, and this combination appears in several other radiograms to be shown.

The Marconiphone Co. Ltd., Blyth Road, Hayes, Middx.

Labgear "Spiral" dual-band indoor aerial for direct connection to the receiver.

MASTERADIO (15)

Complete home entertainment in a single unit seems to have been the aim of the designer of the TRG366, which combines the facilities of a 17-in television set, a radiogram and a tape recorder. Several other new television sets are shown with tubes ranging in size from 14 to 21in.

There is a range of sound broadcast receivers, some of which include the f.m. band and one the trawler band.

Cabinet styles employed include portable, table, console and bureau, the last-mentioned for radiograms.

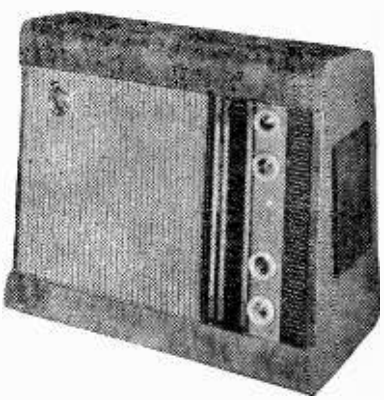
Masteradio Ltd., Fitzroy Place, London, N.W.1.

MULLARD (32)

Applications of electronics in communications, navigation, medicine, industry and commerce will be illustrated by photographs, typical Mullard products and various working devices and demonstrations. There will also be an historical display of radio valves.

For the amateur constructor there will be a special demonstration room, D2A, containing examples of equipment built to Mullard circuits and free technical literature. Technical representatives will be available to answer queries.

Mullard Ltd., Century House, Shaftesbury Avenue, London, W.C.2.



Kolster-Brandes NR30 a.m./f.m. receiver.

MULTICORE (10)

A new solder alloy produced by this firm is said to prolong the life of the soldering bit by preventing the absorption of copper from the bit into the solder. The alloy contains a small percentage of copper. The main feature of the stand will be a demonstration of the new alloy being

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used in the wiring and soldering of Alba midget sound receivers.

Other exhibits will include home constructors' solder for printed circuits, a solder thermometer and a magnetic tape splicer. The well-known BIB wire stripper and cutter will also be shown, with the new feature of 4 B.A. and 6 B.A. spanner holes in the handles.

Multicore Solders Ltd., Maylands Avenue, Hemel Hempstead, Herts.

MURPHY (42)

Television sets with tubes up to 21in and sound broadcast receivers are to be exhibited. The basic 17in models are the V280 (table) and V280C (console) and they are electrically similar to the 14in V270, but not identical. They have turret tuners and vision-channel a.g.c. The V280A (table) and V280CA (console) and V280AD (console with doors) are fringe-area models which differ in having an extra i.f. stage and flywheel sync.

Sound broadcast receivers include the v.h.f. band in their coverage. A v.h.f. mobile radio telephone is also being shown. It is crystal-controlled on both transmit and receive and can be obtained for the bands 60-90 Mc/s, 100-133 Mc/s or 133-174 Mc/s. The receiver is of the double superheterodyne type.

Murphy Radio Ltd., Welwyn Garden City, Herts.

NAVY (303)

A Sea Hawk naval fighter, complete with radio-communication equipment and navigational aids, is the dominant feature of the stand. The Admiralty Signal and Radar Establishment has provided a demonstration showing the use of ferrites in the development of radar and other electronic equipment.

Among examples of marine radio-communication equipment to be seen on this stand is the gear supplied to members of the Royal Naval Volunteer (Wireless) Reserve for use at home and also a complete Royal Marine beach signal station. There is also a section devoted to radio aids to navigation.

The Admiralty, Whitehall, London, S.W.1.

NIXA (5)

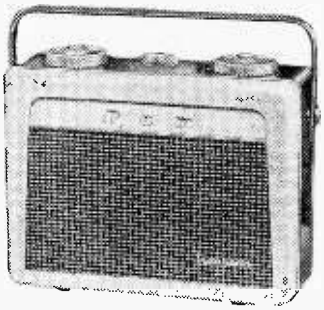
Gramophone discs under this name, and Mercury, Vanguard and Emarcy records which are also marketed by Pye Ltd., will be featured on this stand.

Nixa Record Co. Ltd., 66, Haymarket, London, S.W.1.

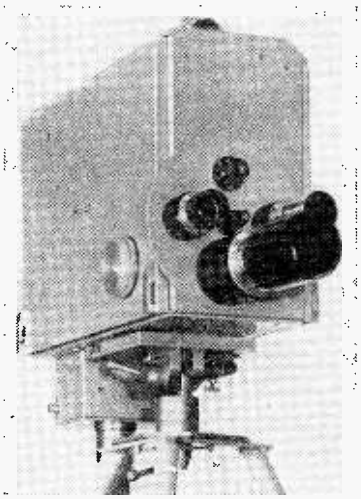
OPPERMAN (319)

The Stirling single-valve Band I/III convertor, from which, it is claimed, there is no radiation, is to be shown by this company, whose main business is the manufacture of aircraft parts.

S E. Opperman Limited, Sterling Corner, Boreham Wood, Herts.



Pam "Transistor" portable.



Peto Scott television camera.

PAM (55)

A superheterodyne portable receiver using transistors throughout will be regarded by many people as being technically the most interesting exhibit on this stand. It covers medium and long waves, has an intermediate frequency of 310 kc/s and consumes only 35 mA from a 6-volt battery. It is built by the printed circuit technique and the push-pull output transistors feed the loudspeaker moving coil directly without a transformer.

A new radio-gramophone (Model 715 RG) incorporates the Collaro four-speed record changer and provides for reception of v.h.f. as well as medium- and long-wave stations.

Pam (Radio and Television) Ltd., 295 Regent Street, London, W.1.

PAMPHONIC (34)

Sound reproduction and reinforcement in all its aspects is represented by the products of this firm which include popular record reproducers, high-quality amplifiers, tuners and loudspeakers, and complete sound reinforcement systems based on the delay principle for use in large auditoria.

A prominent exhibit on this stand will be a 10-kW amplifier for vibration testing made by W. Bryan Savage, Ltd., an associated company.

Pamphonic Reproducers Ltd., 17, Stratton Street, London, W.1.

PETO SCOTT (14)

A feature of the television sets exhibited by this firm is the provision of pre-set r.f. gain and contrast controls for the two bands selected by the band-switching. This is done to obviate the need for adjusting controls when changing from one station to another. Both 14-in and 17-in models are shown.

A television camera is also on view.

Peto Scott Electrical Instruments Ltd., Addlestone Road, Weybridge, Surrey.

PHILCO (22, 317)

Fully transistorized sound receivers, radiograms and record players will be a feature of this stand. The more conventional equipment will include v.h.f. receivers, a three-waveband "torch" receiver, car radios with push-button short-wave converters for use in various parts of the world, and a range of television receivers with screen sizes from 14in to 21in.

An electronic device for use in training electronics technicians will also be displayed, while in the high-fidelity demonstration room D26a there will be a two-channel, four-speaker equipment for high-quality reproduction of gramophone records.

Philco (Great Britain) Ltd., Romford Road, Chigwell, Essex.

PHILIPS (44, 45)

Built-in dipole aerials for v.h.f. will be a feature of several of the a.m./f.m. receivers to be displayed, with ferrite rod aerials for medium and long waves. Also on show will be a 5-valve superhet clock radio and an "easy-to-fit" car receiver, for 6-V or 12-V operation, with a separate 5-in loudspeaker.

Automatic gain control on both sound and vision will be found in most of the television receivers, which range from a 14-in table model to a 23-in console projection set, while flywheel sync is used in the fringe-area models.

The 10-W "Novosonic" high-quality sound reproduction equipment will be demonstrated, and there will be a comprehensive display of radiograms, record players and automatic record changers.

Philips Electrical Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

PILOT (27)

A new model amongst the range of television sets on show will be the 17-in TV107 table receiver, which has a.g.c. on vision, flywheel sync, flyback blanking and a front-facing loudspeaker. Other receivers will range from 14in to 21in.

Sound receivers will include a new

(*Continued on page* 421)

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version of the "Little Maestro" a.c./d.c. 4-valve superhet with a ferrite rod aerial. Also on view will be a.m./f.m. receivers, one of them having a short-wave band, with an alternative version offering the trawler band instead.

Pilot Radio Ltd., Park Royal Road, London, N.W.10,

PLESSEY (9)

The activities of this firm are devoted largely to the production of components, accessories and complete assemblies for the radio industry. This year is displayed a production model, the Type D15, of a loudspeaker working on the novel principle described in the *Wireless World* of January, 1952. Known as the "Ionophone" it has no recognisable moving parts as it functions by direct modulation of ionized air. Its only frequency limitations are those of the horn used with it.

This loudspeaker is particularly suitable as the "high frequency" reproducer in a multi-loudspeaker system, for which application a 2,000 c/s cross-over filter is advised.

Plessey Co. Ltd., Ilford, Essex.

PLUS-A-GRAM (216)

This firm is showing Dansette gramophones. The Minor has a three-speed motor and crystal pick-up and is of the portable type.

J. & A. Margolin Ltd., 112-116 Old Street, London, E.C.1.

PORTOGRAM (66)

Twin elliptical loudspeakers are used in the new "Symphony Four" console record reproducer which incorporates the Collaro RC/456 four-speed changer unit and is designed for the small living room.

Other new models are the "Auto-4-Gram" and "Babygram" portable record reproducers.

The Model HF63 console with omnidirectional sound distribution and the TR100 high-quality reproducer, with alternative combinations of record-player, tape recorder and f.m. tuner, are continued.

Portogram Radio Electrical Industries Ltd., Preil Works, St. Rule Street, London, S.W.8.

PYE (13)

Demonstrations of amplifiers, loudspeakers, a.m./f.m. tuners and record reproducers will be given in room D6, entrance tickets for which will be available on the stand.

A comprehensive range of television receivers, from 14-in to 21-in, will be shown, together with a.m./f.m. sets, portables and radiograms. Also on view will be the "Talk Box" intercommunication system which operates over the electric mains wiring.

Pye Ltd., Cambridge.

R.A.F. (312)

Guided missiles and their associated electronic control and telemetering equipment are to be seen on this stand. The equipment shown in the section devoted to rockets includes a v.h.f. direction finder, u.h.f. gear and teleprinter systems. The training of radio apprentices is also featured.

The Air Ministry, Whitehall Gardens, London, S.W.1.

R.C.A. (103)

Sound reproducing equipment, built to the highest performance standards, and termed "New Orthophonic," will be shown and demonstrated. The basic units are a 20-watt amplifier and pre-amplifier to which may be coupled an f.m. tuner incorporating automatic frequency control and the new 6AL7 tuning indicator.

For record reproduction a transcription turntable is available with a choice of electro-magnetic pickups working on the 8-pole balanced armature principle and sealed against dust by a plastic moulding.

A three-unit cross-over loudspeaker system is housed in a cabinet of similar design to that used for the R.C.A.-Olson loudspeaker.

R.C.A. Great Britain Ltd., Lincoln Way, Windmill Road, Sunbury-on-Thames, Middlesex.

R.G.D. (52)

In the latest radio-gramophone introduced by this firm four loudspeaker units (two 8in × 5in elliptical, one 10in and one small cone "tweeter") are arranged to give wide sound distribution. The radio receiver includes a v.h.f. range, and the record changer has four speeds.

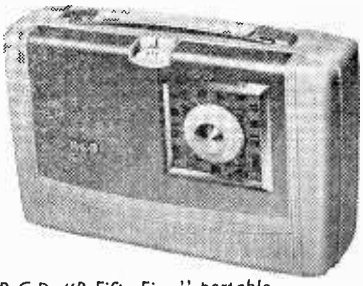
Another new product is the "B Fifty Five" small portable for mains or battery operation with push-button wavelength selection.

The R.G.D. programme includes four television receivers and five other sound receivers and radio-gramophones.

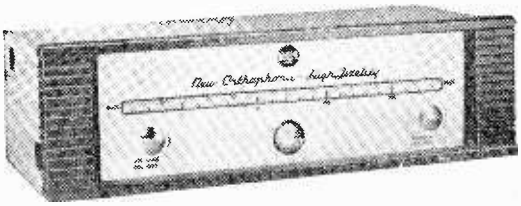
Radio Gramophone Development Co. Ltd., Eastern Avenue, Romford, Essex.

R.S.G.B. (305)

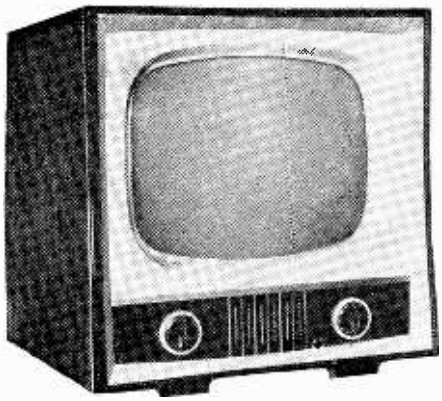
The theme of this stand is "An introduction to amateur radio" and



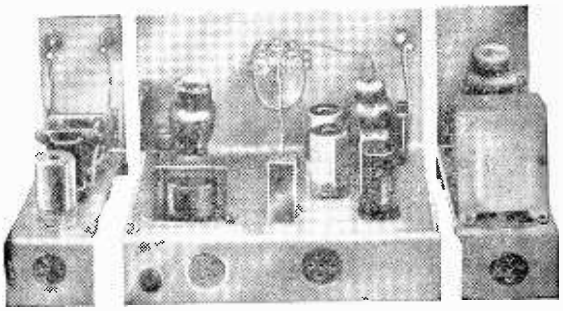
R.G.D. "B Fifty-Five" portable.



R.C.A. f.m. tuner unit.



Pilot 17-in receiver TV107.



Home-constructed communications receiver exhibited by R.S.G.B.

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this is emphasized by a short film "A guide to amateur radio." Among the exhibits is a complete amateur transmitting station including home-constructed transmitting, receiving and frequency measuring equipment. On the stand will also be found other examples of home-constructed equipment including a single side-band transmitter for 144 Mc/s and a communications receiver.

Radio Society of Great Britain, New Ruskin House, 28/30 Little Russell Street, London, W.C.1.

R.T.R.A. (201)

Telesurance—the receiver maintenance and insurance scheme operated by members of the Association—is the main feature of this stand. The scheme, for which the charges vary according to the size of the tube, provides for replacement of defective components, servicing and insurance against burglary, fire and accidental damage.

Radio and Television Retailers' Association, 15/17 Goodge Street, London, W.1.

REGENTONE (60)

A choice of no fewer than 22 models (four television, six sound receivers, seven radio-gramophones and five portable electric gramophones) is offered this year.

The principal new model is the "Continental" radio-gramophone with four-speed record changer, long, medium, short and v.h.f. sound receiver and a three-unit omnidirectional loudspeaker system.

Three other new radio-gramophones include a table model (FM109) with provision for v.h.f. reception.

Two new a.c./d.c. portables (DP2 and DW1) are shown and a "hand-bag" portable ("Double Two") which operates either from batteries or mains.

Regentone Radio and Television Ltd., Eastern Avenue, Romford, Essex.

ROBERTS (48)

This firm continues to specialize in the production of high-grade portable receivers and this year has produced a new compact lightweight model (R66) for a.c. mains or battery operation covering medium and long waves. A ball-bearing turntable is fitted so that the directional properties of the self-contained aerial can be effectively exploited.

Roberts Radio Co. Ltd., Creek Road, East Molesey, Surrey.

ROLA CELESTION (6)

The exhibit is designed to emphasize the wide range of loudspeaker types, both domestic and public address, which are made by this firm. Four new models have been introduced for the domestic market. C10A is a 10-in unit designed to give a smooth response from 65c/s to 10kc/s and may be used in conjunction with the 4-in C4A high-frequency unit (5 to 15kc/s). C8A gives the unusually wide frequency average, for an 8-in unit, of 50c/s to 12kc/s. C68A is an elliptical unit to meet the demands of modern cabinet designs and has a range of 70c/s-12kc/s.

Rola Celestion Ltd., Ferry Works, Thames Ditton, Surrey.

S.T.C. (117)

The ability of silicon rectifiers to work successfully over a wide range of temperatures will be demonstrated by an apparatus which plunges the rectifiers cyclically into chambers at −40°C and 100°C respectively.

Improved performance for a given size is shown by a range of selenium rectifiers, Series 400, the plates of which are coated by a new vacuum evaporation process. Changes in design offer improved mounting and connecting facilities. Selenium is also used in a new range of rectifiers, designed for a.c./d.c. portables, which are notable for their compactness and novel construction.

Standard Telephones and Cables Ltd., Connaught House, Aldwych, London, W.C.2.

SIMON (46)

Tape speeds of 3¾in/sec and 7in/sec are provided in the Model SP/2 magnetic tape recorder. The frequency responses claimed for these speeds are 50-7,000c/s ±3dB and 50-12,000c/s ±3dB. Spools up to 8½-in diameter can be used, and the amplifier, which can be used separately, has an output of 10 watts.

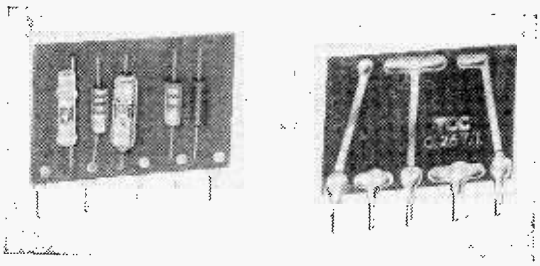
Accessories include a matching v.h.f. tuner unit and a new pressure microphone.

Simon Sound Services Ltd., 48, George Street, London, W.1.

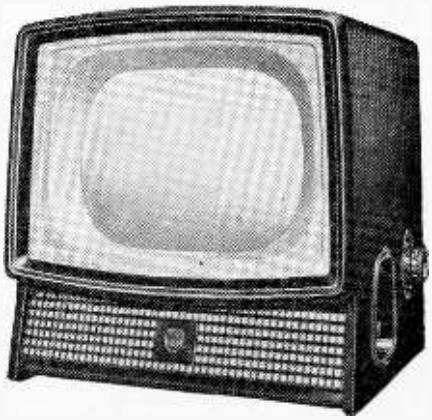
SOBELL (33)

Both 17-in and 21-in table television receivers are shown in table and console styles. Turret tuning and fly-

Simon Model SP/2 tape recorder.



Printed circuit sub-assembly shown by T.C.C.



Ultra V 15—60 table model with 14-in tube.

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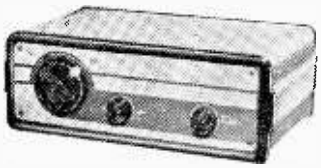


Spencer-West Band III convertor.

wheel sync are employed. There is also one 14-in model.

Sound receivers include the 636WF which covers the f.m. band as well as medium and long waves. A receiver of similar basic form is available with an automatic record player in radio-gramophone form.

Radio & Allied Industries Ltd., Langley Park, Slough.

SPECTONE (316)

A stereophonic magnetic tape reproducer (Model 123) is the main item on this stand. It is built to reproduce tapes recorded to C.C.I.R. standards and incorporates a "Reflectograph" mechanism and two amplifiers based on the Mullard "5-10" design. Model 127 is a smaller version designed to operate with external main amplifiers.

The Spectone "Five Fifteen" range of amplifiers, similar to those used in the magnetic tape reproducer, are available with separate or built-in controls.

Specto Ltd., Vale Road, Windsor, Berks.

SPENCER-WEST (211)

In addition to a range of aerial distribution amplifiers, this firm is to show a Band III pre-amplifier using a double-triode, one stage acting as an earthed-grid amplifier and the other, neutralized, as an earthed cathode.

Several Band III convertors are to be displayed. The Type 66 has a printed circuit. The Type 50 includes a cascode pre-amplifier which is operative on Band I as well as Band III. Other exhibits include a variable aerial attenuator and a pattern eliminator.

A television receiver, Model 1956, has a 9-in tube and is intended rather as an "occasional" set for the nursery or sick-room.

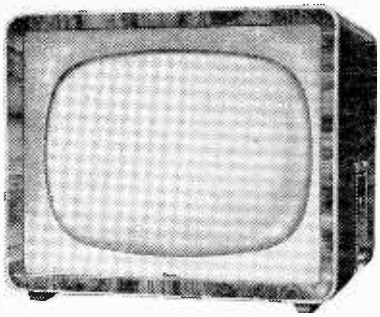
Spencer-West Ltd., Quay Works, Great Yarmouth, Norfolk,

STELLA (56)

The television receivers on view will include a new 17-in table model ST2717U. It has a.g.c. on sound and vision, while the turret tuner covers B.B.C. Channels 1-5 and I.T.A. Channels 8-10.

Reception of v.h.f. programmes is provided for in the new ST24A table sound broadcast receiver and also in the ST238A a.m./f.m. radiogram, which has a 3-speed automatic record

Celestion elliptical loudspeaker (C/68/A).



Sobell T21 table model with 21-in tube. Side controls are fitted.

changer and an 8-in dual-cone loudspeaker. Both of these models have built-in aerials for a.m. and f.m. A mains/battery portable, another table receiver and a portable record-player will also be on show.

Stella Radio and Television Co. Ltd., Oxford House, 9-15, Oxford Street, London W.1.

T.C.C. (64)

While this firm are primarily manufacturers of fixed capacitors and small ceramic trimmers, an important subsidiary activity is the production of printed circuits for the radio and electronic industries. A new development in this field is the use of printed circuit sub-assemblies in conjunction with the main printed circuitry and several examples, principally of capacitor banks, are shown. Printed circuit plates for wafer-switches is also a new development and those made by T.C.C. have either silver- or rhodium-plated contacts.

There is a new range of "Hi-K" (high dielectric constant) miniature lead-through and stand-off ceramic capacitors for use in v.h.f. and u.h.f. tuners, also some "Low-K" trimmers of limited coverage for the same application.

Telegraph Condenser Co. Ltd. Wales Farm Road, North Acton, London, W.3.

TAPE RECORDERS (38)

Modifications to existing models include facilities for mixing inputs and monitoring in the "Editor" tape recorder as well as the "Hi-Fi Editor Super."

A new recorder, to be known as the "Sound" is based on the Collaro "Transcriptor" tape mechanism.

Tape Recorders (Electronics) Ltd., 784-788, High Road, Tottenham, London, N.17.

TAYLOR (106)

Apart from the introduction of several new pieces of test equipment a number of improvements have been effected to the existing range of test sets. Multi-range meters Types 77A and 88A have resistance ranges now extending to 50 MΩ with self-contained batteries, while the Taylor Junior (Model 120A) now has a 5A current range. The electronic test meter, Model 171A, is modified for f.m. discriminator measurements.

Among the newer models is the 94A, a comprehensive television test set embodying an a.m. and f.m. signal generator covering 4 to 230 Mc/s, a pattern generator and a wobbulator. There is a new Model 33A miniature oscilloscope with a 2¾in tube.

Taylor Electrical Instruments Ltd., Montrose Avenue, Slough, Bucks.

TELEQUIPMENT (63)

In addition to the Type WG44 television pattern generator this firm are showing factory-type test equipment and a new Type 4A oscilloscope for checking G.P.O. television lines and terminal equipment. A modified version of this is available for television research applications where a wide-band, high-gain oscilloscope is required.

Telequipment Ltd., 313, Chase Road, Southgate, London, N.14.

TELERECTION (18)

Delta matching of the feeder to the aerial, a principle which obviates the need to use a centre insulator and split dipole, has always been the distinguishing feature of all this firm's television and v.h.f. sound aerials. They also introduced the tilted aerial and still include the feature in some of the multi-element Band I systems.

The most recent addition is a "Double Delta" Band III series of aerials for use in fringe and difficult close-in areas.

Telerection Ltd., Antenna Works, St. Pauls, Cheltenham.

ULTRA (41)

The range of television receivers includes 14-in, 17-in and 21-in tube models. The tuner is of the 13-channel permeability type and includes coils for all channels. Flywheel sync is used and a phase-corrected i.f. amplifier.

The sound broadcast receivers include an a.c./d.c./battery portable and an a.m./f.m. receiver of the a.c./d.c. type. This is also available in radio-gramophone form with a three-speed record changer.

Ultra Electric Ltd., Western Avenue, London, W.3.

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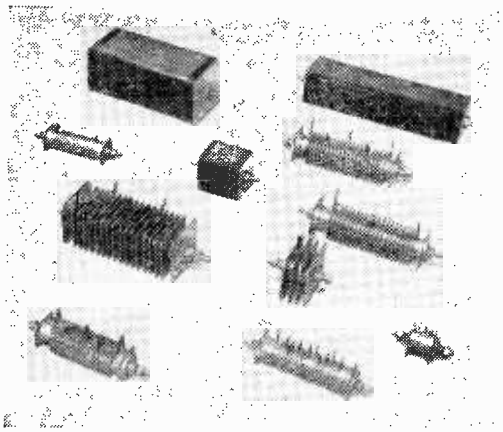
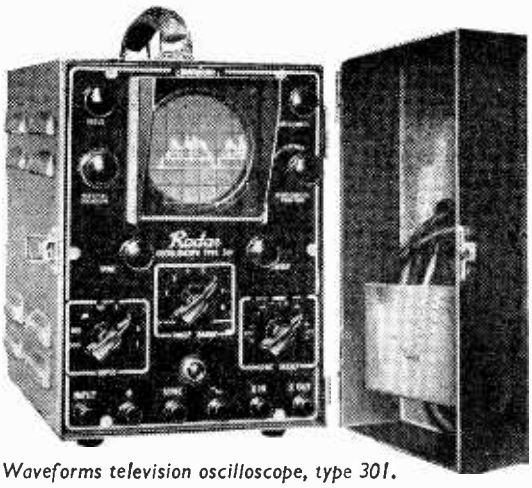


Westinghouse potted and normal rectifiers.



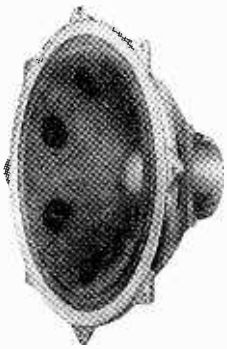
Waveforms television oscilloscope, type 301.

UNITED APPEAL FOR THE BLIND (314)

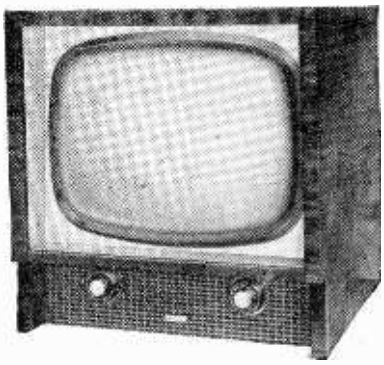
A number of radio factories employ blind people on assembly work; among them are Pye's, whose subsidiary, TV Construction, Ltd., Lowestoft, have provided the demonstration on this stand. Blind operators can be seen producing sub-assemblies for television receivers (Pam 500) and inspecting magslip pillars. For the latter operation Braille-adapted micrometers and gauges are used.

Examples of Braille wiring diagrams on plastic sheeting, a new Braille Avometer and other aids for the blind to work alongside their sighted colleagues are to be seen.

United Appeal for the Blind, 28 Manchester Street, London, W.1.



Whiteley Electrical loudspeaker (HF 1514).



Vidor Model CN4231 turret-tuned television receiver with 17-in tube.

VALRADIO (213)

For operating television receivers, tape recorders and radiograms from d.c. mains or battery supplies a range of d.c.-to-a.c. converters will be exhibited. Also on view will be heavy-duty vibrators for operation from 6V to 250V.

In the field of television there will be 10-, 11-, 12- and 13-channel tuners for home and overseas transmissions, and a range of viewing screens for front-projection television receivers.

Valradio Ltd., Browells Lane, Feltham, Middlesex.

VIDOR (11)

Two new portables make their appearance this year, the "Lady Margaret de Luxe" and the "Vanguard" an a.m./f.m. model. There is also a 45-r.p.m. battery portable record player known as the "Jamboree."

The Model CN4231 table model television set is also new; this has a turret tuner, 17 valves plus two crystal diodes and a metal rectifier and a 17-in rectangular tube with ion trap. A 7×4in elliptical loudspeaker is fitted.

In addition to receivers, Vidor make a very wide range of dry batteries, including hearing-aid types.

Vidor Ltd., Erith, Kent.

WAVEFORMS (205)

The Radar 301 oscilloscope is intended for television work and has a signal amplifier with a 3-dB bandwidth up to 6 Mc/s and a calibrated and frequency-compensated attenuator. It has a Miller timebase with trace expansion to 20 cm. The maximum sweep is 0.5 μsec/cm.

Television signal generators, a c.r.-tube reactivator and an e.h.t. measuring device are among the other exhibits.

Waveforms Ltd., Radar Works, Truro Road, London, N.22.

WESTINGHOUSE (102)

High-temperature lightweight rectifiers, designed to operate at ambient temperatures up to 85°C, will be a feature of this stand. Constructed of aluminium, with cooling fins eliminated to reduce bulk, these units are very light and compact compared with ordinary h.t. rectifiers.

Contact-cooled rectifiers, where the heat is dissipated by chassis conduction rather than convection, will be displayed, and also tubular double- and quadruple-voltage rectifiers in normal and sealed types. The quadruple-voltage units are suitable for e.h.t. supplies in television receivers. Germanium diodes for radio circuit applications will again be featured.

Westinghouse Brake and Signal Company Ltd., 82, York Way, King's Cross, London, N.1.

WHITELEY ELECTRICAL (47)

An unusually wide range of choice in loudspeaker units for high-quality reproduction is offered by this firm, including many with a unique form of cambric cone. A new model, shown for the first time, is a combination of the moving-coil and electrostatic principles.

Cabinets designed to complement the characteristics of the various loudspeaker units are available and are supplied packed flat ready for home assembly with a screwdriver.

The WB12 quality amplifier and pre-amplifier appears in improved form and is now supplemented by a v.h.f. tuner unit.

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A large part of the stand is devoted to examples of the versatility of Whiteley Electrical's manufacturing facilities for making components and instruments, such as the meteorological "radio sonde," for the Services, science and industry.

Whiteley Electrical Radio Co. Ltd., Victoria Street, Mansfield, Notts.

WOLSEY (2)

A new Band III aerial for loft mounting is introduced this year; it has a ball joint cross-arm fitting enabling the aerial to be mounted on sloping beams yet having the elements vertical or horizontal and oriented as required. Three- and five-element models and a full range of outdoor types will be shown.

A special display is made of combined aerials embodying "arrowhead" style Band III elements. These are intended for use where the B.B.C. and I.T.A. stations are co-sited or virtually so.

A Band III convertor with turret tuning for the oscillator is now available. A cascode r.f. stage is used and the gain is 20 dB.

Accessories include cross-over networks, 75 to 300Ω balun couplers and a solderless cable plug.

Wolsey Television Ltd., 43-45, Knight's Hill, West Norwood, London, S.E.27.

WOOD & METAL INDUSTRIES (315)

A spring-loaded castor is to be exhibited on this stand. The weight is taken by a thrust ball bearing against a spring so that, in addition to the normal action of a castor, there is a buffering action against shocks in the vertical plane.

Wood & Metal Industries Ltd., Seymour Road, Leyton, London, E.10.

LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

Noise in Carbon Resistors

THE article on "Characteristics of Fixed Resistors," by G. W. A. Dummer (*Wireless World*, June, 1956, p. 263), has probably suffered through being over-compressed from the author's book, but the note on the frequency spectrum of current noise calls for comment. Whereas Dummer refers to the spectrum of current noise "from below about 10 c/s", experiments on carbon composition resistors (Rollin and Templeton, *Proc. Phys. Soc. B*, 1953, vol. 66, p. 259) have shown that the inverse frequency power spectrum continues to as low a frequency as can be measured, which is so far a frequency of the order of a thousandth of a cycle per second. For carbon the spectrum follows very closely the law $E^2 \propto \Delta f/f$ where Δf is a narrow pass-band centred on f. The noise in equipment of considerable bandwidth from f_1 to f_2 then has squared voltage proportional to the *logarithm* of the ratio f_1/f_2, not to the direct ratio as stated in the article.

The figures given in Table 3 are, of course, arbitrary acceptance limits, and related to the physical mechanism only empirically if at all. I have not a copy of RCS specifications to hand, so could the author please tell us what is the formula now used for the maximum acceptable noise from cracked-carbon resistors, in place of the rule of 0.5μV/V which was employed a year or two ago?

I assume that the + and − signs in Fig. 6 have been copied from Fig. 5 by mistake, since R_{rf} will not become negative. But why is it stated categorically (No. 3 of the conclusions) that a resistor for use at radio frequency should be of the film type when a rule has previously been given for the behaviour of *composition* resistors up to 1500 Mc/s?

To continue dotting i's and crossing t's, may I say to "Cathode Ray" that there is no harm in using a composition resistor across the input of a high-gain amplifier *provided there is no steady current in it.* I have often used composition resistors as a source of standard noise levels for the calibration of high-gain amplifiers, and all measurements show that at zero mean current the composition resistor produces good honest Johnson noise.

D. A. BELL.

Electrical Engineering Department,
The University, Birmingham 15.

Technical Training

YOUR correspondent, S. J. Coe (issue of May, 1956), has apparently been misled into believing that City and Guilds certificates in Telecommunications Engineering can be gained only by those students who attend recognized technical college courses. This is not so.

The City and Guilds of London Institute, whilst strongly recommending attendance at a technical college wherever possible, has always recognized that there will be many students for whom no courses are available. This is particularly true in the case of the more advanced levels where the small numbers often preclude the establishment of appropriate college courses. The Institute has accordingly made special provision in its Regulations for the acceptance of such students as external examination candidates, and the Intermediate, Final and Full Technological Certificates in Telecommunications Engineering are available equally to internal and external entrants.

A perusal of the Institute's Regulations would have revealed to Mr. Coe that he could have made an entry to the examinations as an external candidate merely by applying to the authorities of the nearest technical college in February, seeking accommodation for the tests which take place in May.

CYRIL LLOYD.

Director, City and Guilds of London Institute.

Television Film Quality

YOUR Editorial on broadcasting from recordings (June issue) has stimulated me to comment upon the use of film in television. There are two aspects of this, the technical and the artistic, and I must say that very many of the films recently televised can only be considered thoroughly bad on both counts.

Good films are technically possible on television and as instances I may cite the old B.B.C. newsreels and many of the Peter Scott wild-life pictures. All too often, however, the picture is so lacking in tone gradation that a man in a dark suit is little more than a silhouette, while the sound quality is of the kind generally known as 90 per cent distorted.

Artistically, many of these films fail because they have been produced to suit the conditions of mass reaction which exists in the cinema but not in the television audience. Quite a different style of production is needed for television, but even then it can only compare unfavourably with "live" television. If anyone doubts this statement he has only to watch one of those programmes which is a mixture of "live" scenes and of film. It is very instructive to notice how the film breaks up the continuity of the programme and destroys the illusion of reality. The effect on the

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viewer is exactly the opposite to what the producer obviously intends.

It may be objected that the viewer cannot distinguish film from "live" television when the film is good. He may sometimes be deceived into thinking it is a "live" show with rather a poor camera. But there is no disguising the horrible jerky motion in horizontal panning shots which is a peculiarity of film and which is as evident in the cinema as in televised films.

W. TUSTING.

Measurement of Rise-time

IN the February, 1955, issue of *Wireless World*, E. G. Dann described a method of measuring rise-time by replacing the normal timebase of an oscilloscope by an r.f. generator. However, he does not give the order of recurrent frequency of the square waves which may be measured by this method. Owing to the great difference in the frequency of the square waves, and that of the r.f. waves required to display several cycles during rise-time, there can never be sufficient constancy of frequency in practice to obtain a steady trace.

The problem is solved, however, if a multivibrator is locked on to the r.f. generator and the output from the "multi" used to trigger the square wave generator at its fundamental frequency. A rock-steady display is then readily obtained. Since a "multi" will lock quite positively as far as its tenth harmonic, by employing several in series, rise-times of the order of millimicroseconds may be measured for pulses or square waves where recurrent frequency is as low as a few cycles per second.

London, N.2. VICTOR DUMERT.

Music Stations?

IN the Editorial of the August issue you say the B.B.C.'s v.h.f. service must be used mainly to reinforce transmissions on the normal wavebands, and cannot be conducted entirely, or even mainly, for those whose principal interest is in high-quality reproduction of music.

I suggest there are good reasons why at least one channel in each region might be devoted to items whose value is most dependent on high-quality reproduction; i.e., to music, more or less exclusively. The increase in interference on the a.m. bands has surely diminished their value for music transmissions very much more than for speech.

Hampton Hill, Middx. J. S. PRESTON

Grandfather Clock Effect

WHEN the I.T.A. got going one of my colleagues made the necessary alteration to his receiver and sat back to enjoy the programme. At once he noticed a cyclic disturbance, slight on the picture, and more pronounced on the sound. As this effect was always present on the I.T.A. transmission and never on the B.B.C. he concluded that the trouble came from their end, so, with his faith in private enterprise slightly shaken, he just left it at that.

One day the penny dropped, so to speak, and he noticed the disturbance was exactly in phase with the pendulum of his grandfather clock. Stopping the clock stopped the interference, and vice versa.

This phenomenon is less obscure than the "Bournemouth Effect" described by your contributor "Diallist" and the cure is obvious, but so far my advice to re-orient the clock, and/or fit it with a non-metallic pendulum, has aroused no enthusiasm.

Although this case may not be unique, it is certainly the first time I have heard of a weight-driven clock causing radio interference!

London, S.E.9. A. L. HUTTON.

Morse Information

IT must surely have been a slip of "Free Grid's" usually accurate pen which led him to say (August issue) that letters in most frequent use convey most information. The opposite it true; they convey least.

The more unexpected a signal is, the more information it conveys. In the absence of any special indications the most likely letter is E, we are not surprised when we receive it and when we have received it we have not increased our total information by much. In a good code, therefore, it should not occupy much time. By the same argument we do not expect to receive Z very frequently in the English language, and hence it conveys a lot of information and justifies a long signal.

Brentwood, Essex. W. D. H. BLACKMAN.

Aerial Cross-over Network

THE formulæ quoted by L. S. King (June issue) for a prototype half-section are not correct and should be:—

$$L_1 = L_2 = \frac{R_o}{2\pi f_c} \quad (1)$$

$$C_1 = C_2 = \frac{1}{2\pi f_c R_o} \quad (2)$$

(See Appendix, page 295)

Hence for $f_c = 95$ Mc/s (cross-over point)

$L_1 = L_2 = 0.126\ \mu H$ and $C_1 = C_2 = 22$ pF

I would also like to know how Mr. King obtained different values for L_1 and L_2, and C_1 and C_2 which according to (1) and (2) should have been the same.

London, N.W.2. J. KASON.

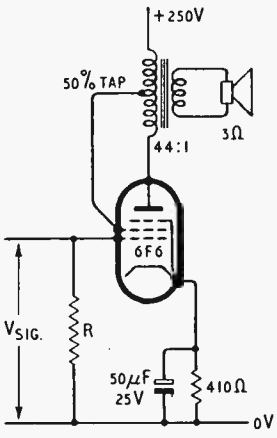
The Author Replies

J. KASON is, of course, correct in his criticism of the formulæ in the Appendix to my article. I quoted the usual formulæ for *full*-sections and inadvertently said that they were for half-sections. The formulæ were used correctly in determining the filter constants quoted and the error affects nothing in the body of the article.

L. S. KING.

VL Amplifiers

IT may not be generally appreciated that the benefits of the "ultralinear" circuit for pentodes and tetrodes are not confined to the pushpull case. Having the data available I worked out the figures for a 6F6 valve and the results looked very promising for 30%, 40% and 50% taps. It was most convenient to test the 50% tap using a small multi-ratio pushpull output transformer which presented a 5,800-ohm load to the valve, the optimum being estimated as 6,000 ohms. The values used are shown in the diagram. R may be of any value between 220kΩ and 560kΩ. This value, together with the coupling capacitor to the previous stage may be chosen for the desired bass characteristic.



Audible results are very satisfactory. The small transformer does not cope with bass tones so a deliberate cut is introduced from a turnover of 180 c/s. The middle and top registers are level and clean, and only sustained bass notes suffer by comparison; e.g., organ diapason and the low strings. As might be expected from the estimated distortion the individual instruments of an ensemble retain their identity. 10 dB feedback over two stages has very little "cleaning-up" effect but is valuable for damping the cone excursion at bass resonance.

The power output drops from 3W at 4 to 6% distortion to 2W with less than 0.3%. The 1.7 dB loss is negligible and if the straight pentode connection is reduced to 2W the distortion is still 3 to 4%.

London, S.E.4. W. GRANT.

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Switched-Tuned F.M. Unit

Automatic Frequency Correction by Means of a Reactance Valve

By JOHN M. BEUKERS, B.Sc., (Eng.), Grad. I.E.E.

WHEN an f.m. receiver incorporating a ratio detector or a discriminator of the Foster-Seely type is tuned through an f.m. transmission there are three points at which detection occurs and two where severe distortion sets in; this phenomenon is due to the S-shaped characteristic of the detector which is illustrated in Fig. 1a.

The correct portion of the response curve for detection to take place is that lying between the two peaks (C, D, on Fig. 1a), and for minimum distortion this should be as straight as possible. It is usual to make the "peak separation" considerably more than the maximum peak-to-peak frequency deviation to be expected of the carrier to which the receiver is to be tuned; for example, 100% modulation of a B.B.C. carrier corresponds to a frequency deviation of $\pm$ 75 kc/s or 150 kc/s peak-to-peak, the peak separation of the discriminator would be some 300 to 400 kc/s.

The sensitivity of the detector is defined by the slope of the centre portion of the curve and since the latter is substantially straight the sensitivity remains constant over some 200 to 300 kc/s; in other words the audio output level remains constant while tuning over the useful portion of the curve. Thus if a receiver using this form of detector is tuned by ear the unsatisfactory situation may arise where the carrier is centred at one end of the working portion of the characteristic. The result is that normal distortion-free reception is obtained when the modulation is at low level but modulation peaks may be severely distorted.

Tuning indicators, if used, should work from voltages developed by the discriminator and not be peak-carrier indicators, since if the i.f. amplifier and discriminator are not exactly in alignment the receiver will be tuned to the centre of the i.f. pass-band (or if the coils are over-coupled, to one of the peaks in the pass-band) and not to the centre of the discriminator characteristic. Of the two zero frequency voltages available from the discriminator, one is constant (V_{ab} Fig. 1b) over the pass-band and the other is zero when the receiver is in tune (V_0 Fig. 1b)[6]; this makes the design of suitable indicators a little troublesome. Two tuning indicators suitable for f.m. receivers have been described in *Wireless World*[1, 2].

The two discriminators mentioned give maximum a.m. rejection at the centre of their characteristics. It is therefore possible to tune the receiver for minimum background noise, but this is often difficult because the noise is masked by the programme.

Switch tuning removes the difficulties of manual tuning and makes a tuning indicator superfluous; as far as non-technical users are concerned pre-set tuning of an f.m. carrier is a blessing and whilst there are only the three B.B.C. programmes on Band II the writer feels there is much to be said for the system.

Some Problems.—For a switch-tuned system to

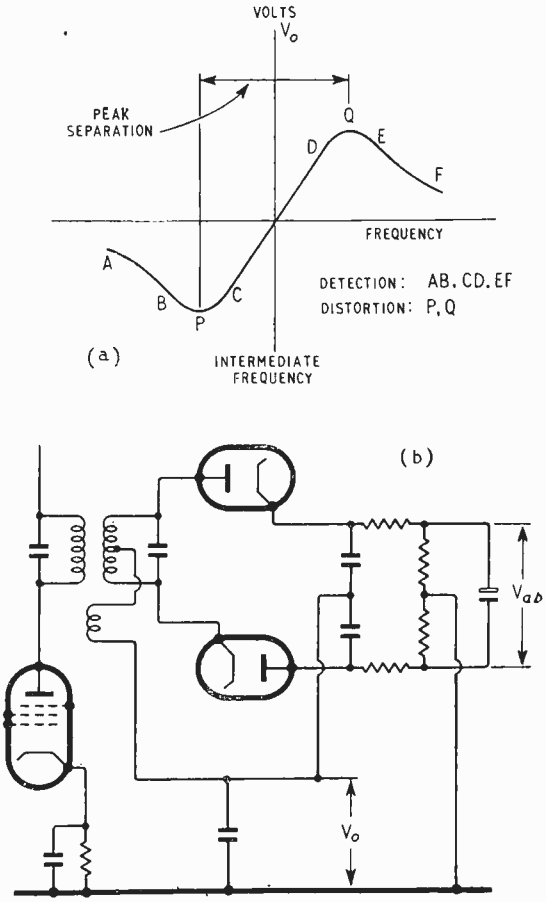

Fig. 1. (a) response characteristic of the discriminator: (b) the circuit arrangement.

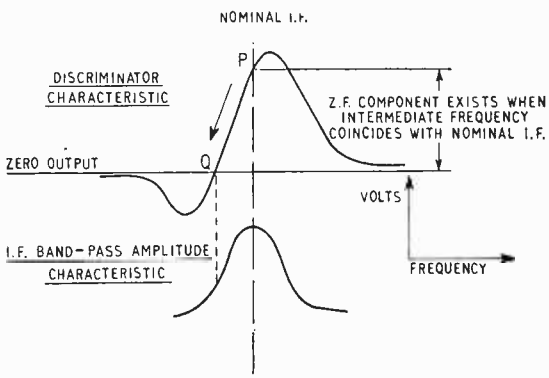

Fig. 2. A.F.C. will shift the i.f. from the nominal point P on discriminator characteristic to point Q.

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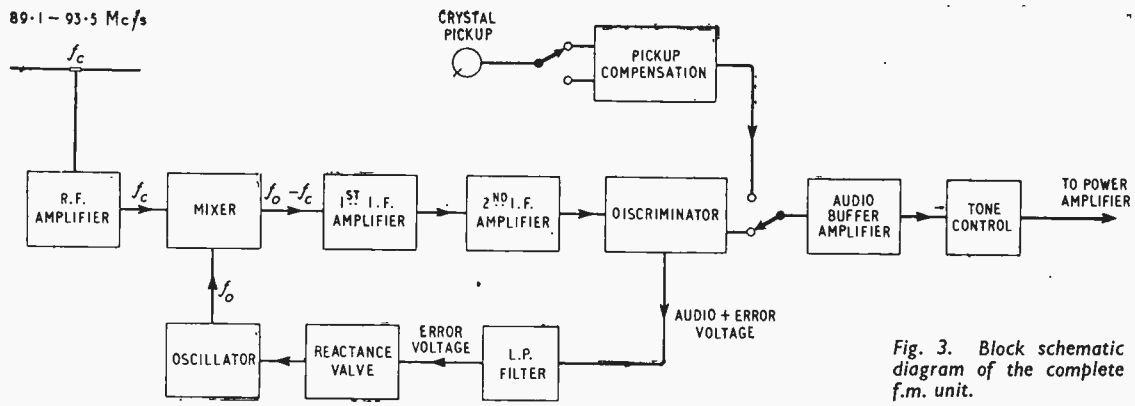


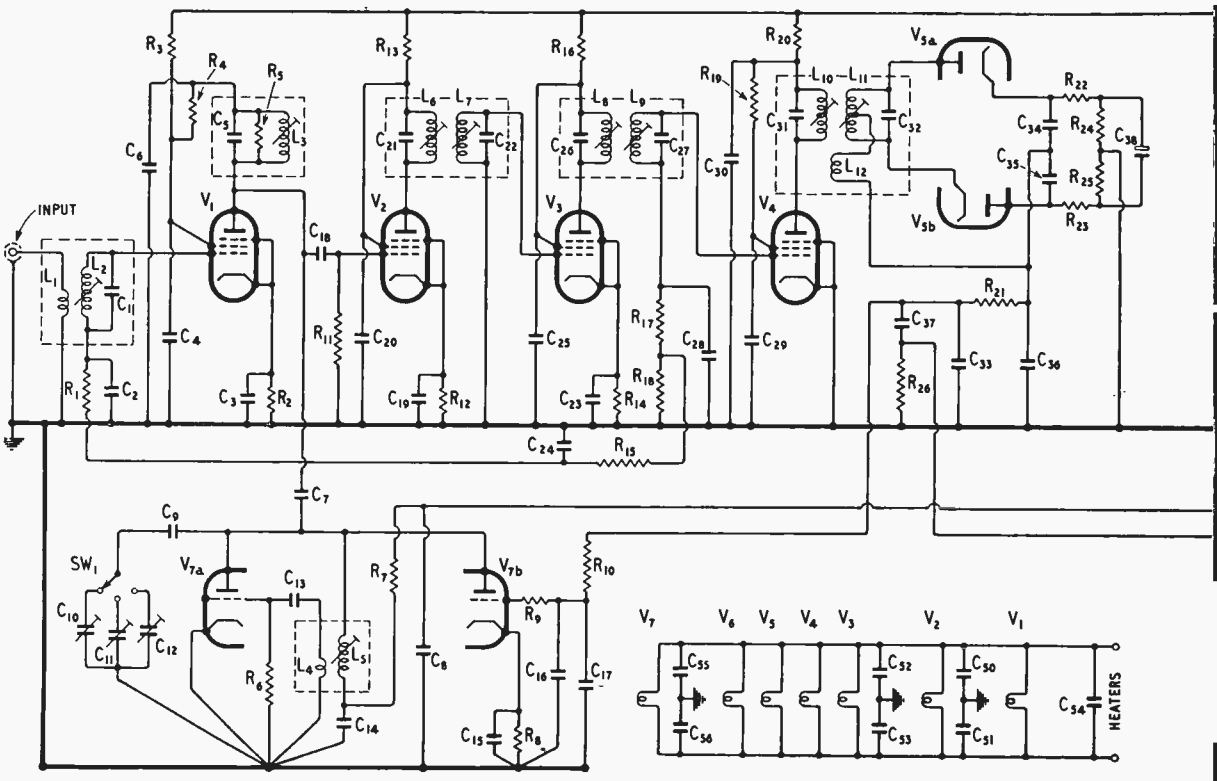
Fig. 3. Block schematic diagram of the complete f.m. unit.

operate satisfactorily the stability of the oscillator must be such that when the receiver is switched on from cold the intermediate frequency produced by mixing the oscillator frequency with the desired carrier lies not far from the centre of the discriminator characteristic; as the receiver warms up drift of the oscillator should shift the intermediate frequency to the centre of the detector characteristic.

Receivers for use on Band II will in general have their oscillators running at about 100-110 Mc/s and at this frequency it is virtually impossible to obtain a simple lumped LC oscillator of the required stability. Negative temperature coefficient capacitors can be used giving an improvement, but drift during the first two or three minutes while the oscillator valve is warming up cannot be entirely overcome. The use of crystal oscillators, one crystal for each programme is one solution[3]; another is to use automatic frequency correction. A.F.C. may be applied in a number of ways, one of which was described in this journal recently[4]. The present receiver uses a reactance valve and derives the necessary error voltage from the discriminator.

It is not possible to obtain perfect correction using this method of a.f.c. for the following reason. When the intermediate frequency is shifted by the reactance valve towards the centre of the discriminator characteristic the zero frequency error voltage is reduced and thus a point of equilibrium will be reached somewhere between the centre frequency and the uncorrected frequency. The more "sensitive" the reactance valve the more perfect the correction; in the present design the off-tune error is reduced by between seven and ten times.

Fig. 4. Theoretical circuit diagram of the f.m. unit.



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LIST OF PARTS

Resistors*

R_1, R_{29}.	10 kΩ
R_2, R_{12}, R_{14}.	180 Ω, 10%
R_3, R_4, R_{13}, R_{16}, R_{20}, R_{22}, R_{23}, R_{34}.	1 kΩ (R_{22}, R_{23} to be 10%)
R_5.	1.8 kΩ
R_6.	33 kΩ
R_7.	2.2 kΩ
R_8.	680 Ω, 10%
R_9.	100 Ω, 10%
R_{10}, R_{26}, R_{39}, R_{41}, R_{43}.	2.2 MΩ
R_{11}, R_{15}, R_{40}.	1 MΩ
R_{17}, R_{18}, R_{19}, R_{21}, R_{31}, R_{33}, R_{35}.	100 kΩ (R_{31}, R_{33} to be 10%)
R_{24}, R_{25}.	6.8 kΩ, 2%
R_{27}, R_{32}.	470 kΩ
R_{28}.	4.7 kΩ, 10%
R_{30}.	82 kΩ
R_{36}.	22 kΩ
R_{37}.	3.3 kΩ, 10%
R_{38}.	wirewound (value to suit h.t. supply)
R_{42}.	1.5 MΩ
R_{44}.	150 kΩ
RV_1.	1 MΩ pot, linear law
RV_2.	500 kΩ pot, with centre tap (Dubilier).

Resistors (continued)

RV_3.	500 kΩ pot, log law

Capacitors†

C_1.	4.7 pF, 10% (Erie Ceramicon, N750)
C_2, C_3, C_4, C_6, C_{14}.	0.001 μF ceramic
C_5.	10 pF ceramic
C_7.	2.2 pF, ±½ pF (Erie Ceramicon, P100)
C_8, C_{15}, C_{16}, C_{55}, C_{56}.	0.0015 μF lead-through ceramic
C_9.	15 pF (Erie Ceramicon, N750).
C_{10}, C_{11}, C_{12}.	2 to 10 pF trimmer
C_{13}.	33 pF, 10% (Erie Ceramicon, N750)
C_{17}.	0.25 μF, metallized paper
C_{18}.	47 pF, 10% (Erie Ceramicon, N750)
C_{19}, C_{20}, C_{23}, C_{25}, C_{29}, C_{30}, C_{50}, C_{51}, C_{52}, C_{53}, C_{54}.	0.005 μF, Ceramic
C_{21}, C_{22}, C_{26}, C_{27}.	50 pF, 5%, silvered mica (see text)

Capacitors (continued)

C_{24}, C_{37}.	0.1 μF, 150V wkg., metallized paper
C_{28}.	22 pF, 10% (Erie Ceramicon, N750)
C_{31}.	10 pF, ±½ pF, (Erie Ceramicon, N750)
C_{32}.	39 pF, 5% (Erie Ceramicon N330)
C_{33}.	470 pF, 10%, silvered mica
C_{34}, C_{35}, C_{36}.	330 pF, 10%, silvered mica
C_{38}.	12 μF, electrolytic, 50V wkg.
C_{39}.	2 μF, electrolytic
C_{40}, C_{44}.	0.1 μF paper
C_{41}, C_{42}.	0.005 μF, 10% matched, paper
C_{43}, C_{47}.	100 pF, 10% silvered mica
C_{45}, C_{46}.	8 μF, electrolytic
C_{48}.	0.001 μF, 10%, silvered mica
C_{49}.	250 pF, 10%, silvered mica

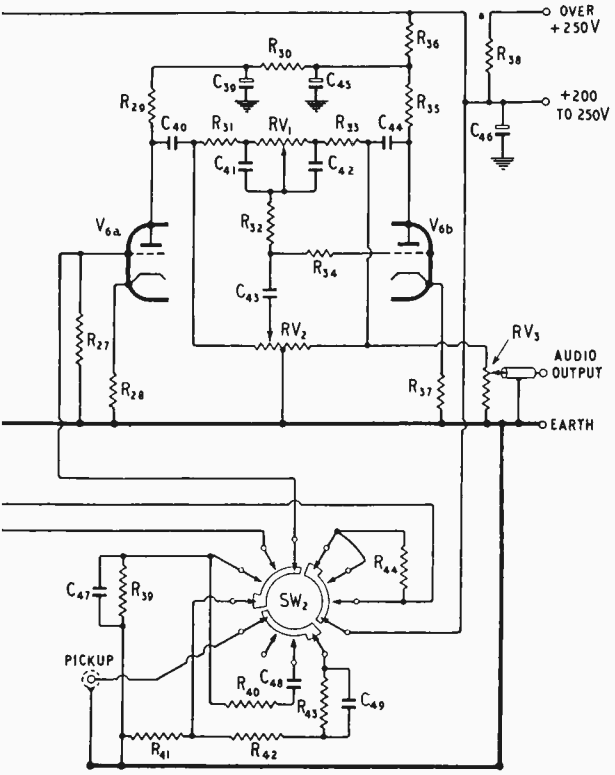
Valves

V_1–V_4.	6AM6
V_5.	6AL5
V_6.	12AX7
V_7.	12AT7.

* (20% tolerance, ¼W unless otherwise stated)

† (20% tolerance, 350V wkg. unless otherwise stated)

The application of a.f.c. immediately raises a problem, that of frequency stability of the i.f. and discriminator tuned circuits with changes of temperature. If the discriminator characteristic is not symmetrical about the nominal intermediate frequency employed then a zero frequency voltage exists when the intermediate frequency lies in the centre of the i.f. pass-band. The voltage will be fed back to the reactance valve (or any other device producing a.f.c.) which will shift the oscillator frequency thus bringing the intermediate frequency to one side of the i.f. pass-band as illustrated in Fig. 2. This may lead to deeply modulated signals being distorted due to working on the non-linear portion of (a) the discriminator characteristic and (b) the phase/frequency characteristic of the i.f. tuned circuits. To minimise drift of these circuits with temperature the positive temperature coefficient of the coil should be compensated by negative temperature cofficient capacitors.



The Receiver.—This is based on a design by Amos and Johnstone published in *Wireless World* last year;[1] those sections that have been modified are described in detail in this article. The reader is, however, referred to the original article for more information on the points not discussed.

The block diagram and the circuit are shown in Figs. 3 and 4 respectively. The received signal f_c is fed into a tuned circuit designed to give a fair match between the aerial and the grid impedance of the r.f. amplifier. The local oscillator, which operates at a frequency above the received signal, is mixed with the output of the r.f. amplifier to produce an intermediate frequency f_0-f_c. V_3 and V_4 comprise the i.f. amplifier, V_3 being a straightforward amplifier working at full gain and V_4 a high-level limiter the output of which feeds a ratio detector. To complete the unit a tone control has been incorporated and provision made to take the output from a crystal pickup. To make this possible a double triode is included, one half of which is used as an RC coupled amplifier and the remaining half the tone control to a design by P. J. Baxandall.[5]

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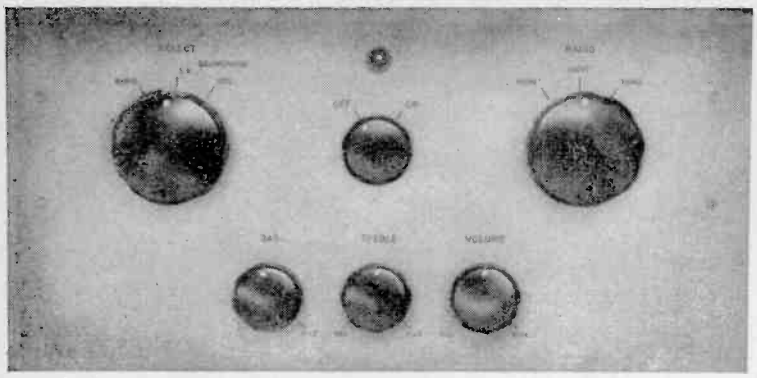


Front panel layout of the unit.

The pickup is provided with a simple RC compensation for standard and long playing records, switching being effected from the front panel. The output level from the audio stages with the tone controls set to their mid positions is approximately one volt r.m.s. on both radio and gramophone.

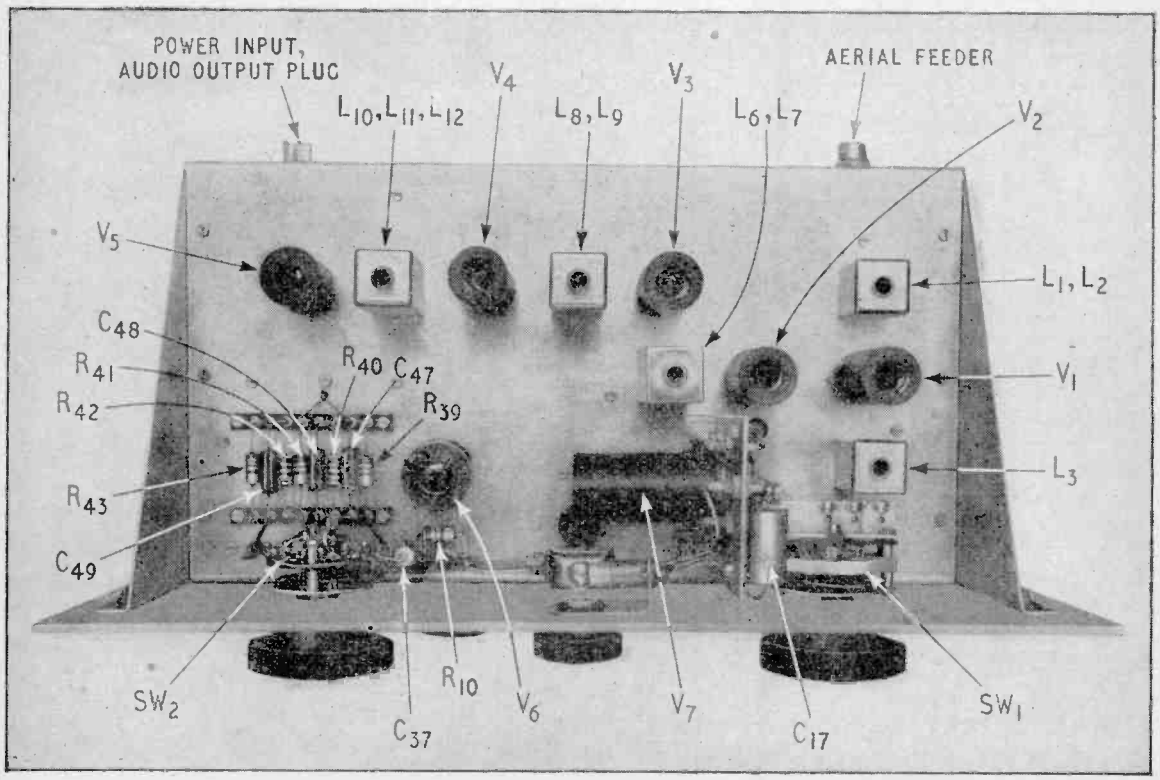
The R.F. Stage.—The transmissions of the Home, Light and Third programmes on Band II from any one transmitter are spaced by 2.2 Mc/s and thus cover a band of 4.4 Mc/s. In the r.f. stage tuning of both grid and anode circuits is fixed and peaked to the middle of the band; this means that the bandwidth to the 3-dB points of the r.f. stage must not be less than 4.4 Mc/s in order that the sensitivity of the receiver on the three programmes remains substantially constant.

The grid circuit will unavoidably be of low impedance and low Q due to the input resistance of the valve and the loading of the aerial. Assuming a grid circuit Q of about 5 the anode circuit Q should be approximately 18. The natural coil Q will be very much higher than this value and therefore the coil must be damped down to give the required value of Q; this is effected by R_5.

I.F. Coils.—The spacing between the windings in the i.f. coils is very critical as has previously been pointed out[1] and this cannot be too greatly stressed. It must be remembered that unlike the reception of an a.m. transmission where insufficient bandwidth, or a distorted pass-band (amplitude) results in a poor frequency response, an f.m. transmission could suffer harmonic distortion which is far less tolerable. A method of achieving maximum phase linearity from the i.f. amplifier and discriminator tuned circuits is outlined in the alignment procedure.

For optimum results from the a.f.c. the i.f. coils should be temperature compensated; to do this the 50-pF silver-mica tuning capacitors should be replaced by two capacitors one with a positive and one with a negative temperature coefficient. The method for determining the values of these capacitors is given in the Appendix. In general a single layer inductor at the frequency employed for the i.f. will have a temperature coefficient of about plus 40 parts/million/°C, to compensate for this the combination

Layout of the top of the chassis of the pre-tuned f.m. unit. The annotation shows location of the principal parts.



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of the two capacitors should have a negative temperature coefficient of the same value.

The Detector.—The ratio detector provides an output voltage which can be readily used for a.f.c. It has already been shown (Fig. 1a and b) that at the centre frequency (the frequency to which the i.f. coils and discriminator are tuned) the output voltage V_o from the discriminator is zero, and that if there is a frequency shift in either direction from the centre frequency a zero frequency voltage will be produced which will increase either positively or negatively with frequency depending upon the orientation of the diodes. A reactance valve when fed with this voltage can be used to change the frequency of the oscillator such that the intermediate frequency is shifted towards the centre of the discriminator characteristic. It is essential to wire the diodes correctly; if they are wired the wrong way round the zero frequency voltage fed back will tend to shift the oscillator frequency such that the intermediate frequency is moved away from the centre of the discriminator characteristic. It will be quite obvious if the diodes are the wrong way round since it will be impossible to tune the receiver to a carrier.

Low-Pass Filter.—When the receiver is tuned to a modulated carrier and the intermediate frequency is not quite coincident with the centre of the discriminator characteristic the output from the discriminator will contain two components (a) the zero frequency error voltage and (b) the audio output; normally the zero frequency component is blocked off with a capacitor and the audio is fed to further audio stages. To use the output from the discriminator for a.f.c. it is necessary to separate the zero frequency component from the audio, this is done in a low-pass filter consisting of R_{10}, 2.2 MΩ, and C_{17}, 0.25 μF.

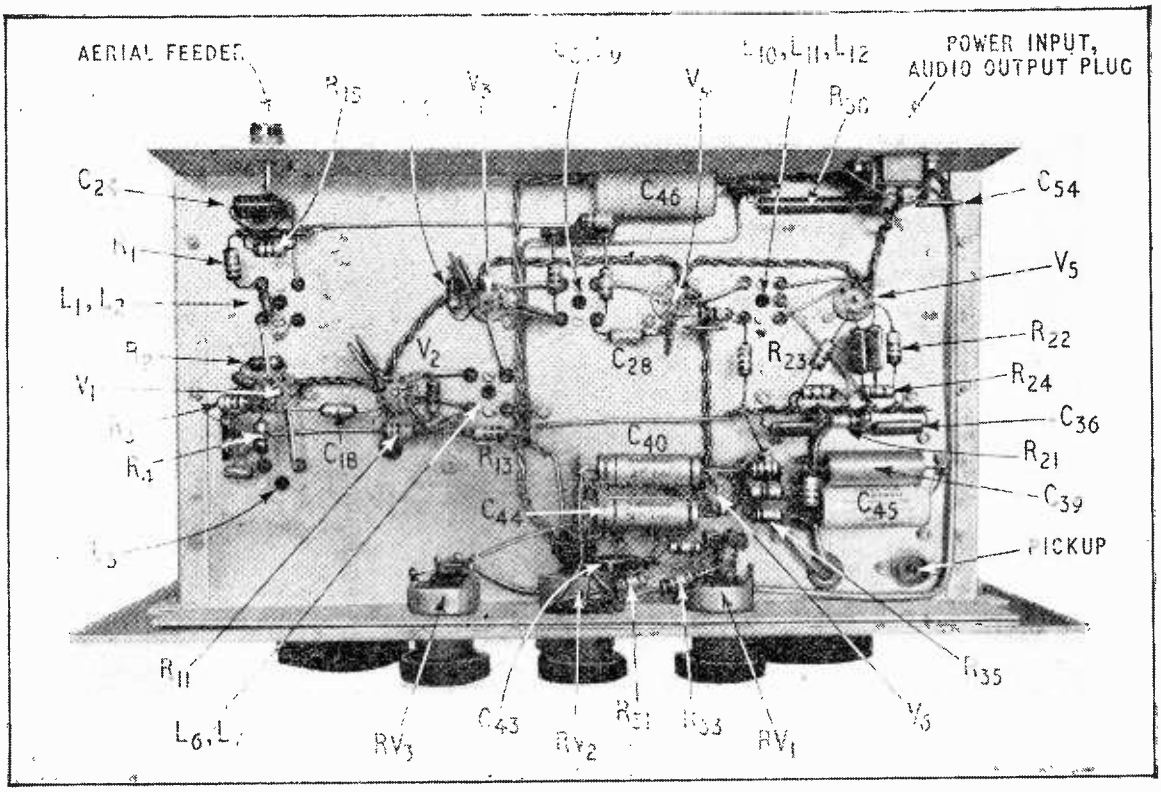
Applying the audio to the reactance valve is a form of negative feedback since the reactance valve adjusts the oscillator so as to oppose any output voltage from the discriminator. It is interesting to note the possibilities of putting the de-emphasis network in the feedback path so that top cut is produced by reducing the deviation of the transmission at the higher frequencies.

Reactance Valve And Oscillator.—The reactance valve and oscillator is perhaps the most interesting section in the unit and for this reason a a fair amount of detail is given, both electrical and mechanical. At the oscillator working frequency (around 100 Mc/s) the size, type, quality, placing of the components and position of wiring are of significance, for this reason it is unadvisable to change the layout and/or components without considering the effect of the change of distributed elements of the circuit. (By which is meant lead inductance, stray capacity and chassis r.f. resistance).

It may not be obvious from the circuit diagram how the reactance valve changes the oscillator frequency. A clearer picture may be obtained from Fig. 5 which depicts the reactance valve with only those components responsible for the working of the device.

C_{ag} and R_p form a phase-shift network such that at 110 Mc/s the grid voltage (V_g) is out of phase with the anode voltage (V_a) and thus the valve draws a current I_r having two components, one resistive which damps the oscillator tank circuit and one reactive which has the effect of altering the total reactance present, this in turn changes the oscillator

Underside view of the chassis. Note the twisted a.c. heater leads and that the components form the bulk of the wiring.



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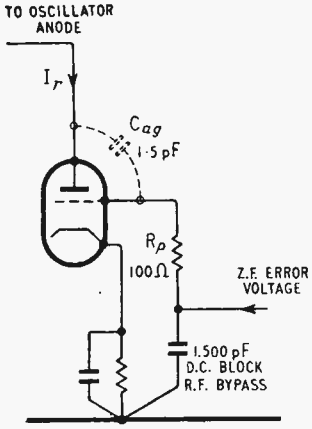


Fig. 5. Details of the reactance stage.

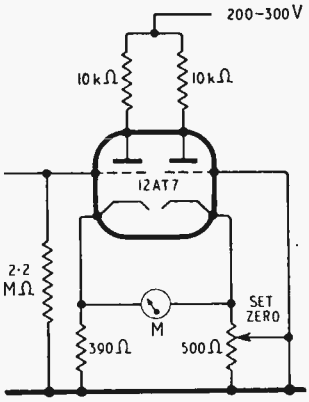
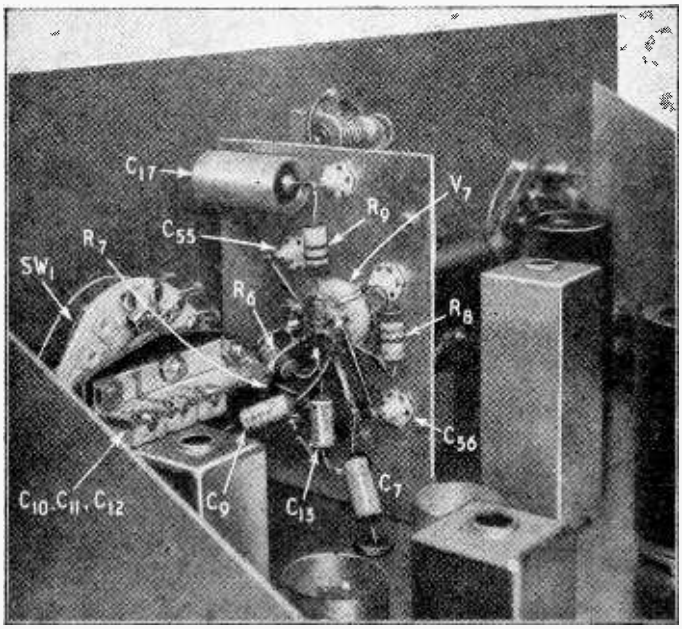


Fig. 6. Suggested circuit for a simple valve voltmeter.



Details of the oscillator sub-assembly and select switch.

frequency. To increase or decrease I_r it is only necessary to vary the bias (and hence *gm*) on the reactance valve, this is done by the zero frequency component from the discriminator.

If the grid potential of the reactance valve is raised the frequency of the oscillator is lowered and this at once fixes the orientation of the diodes in the discriminator. The discriminator must be wired so that if the intermediate frequency increases, a positive voltage is fed back to the reactance valve which will tend to lower the oscillator frequency.

The design of the oscillator is quite conventional, but there are one or two points to mention. There is no physical capacitor across the anode coil, the tuning capacitance is made up of the valve electrode capacitance, the wiring and the trimmers. In order to make the a.f.c. reasonably sensitive the total tuning capacitance should be kept small, this should be borne in mind when aligning the receiver. The oscillator coil consists of an anode winding and a grid feedback winding; the anode winding is of No. 18 s.w.g. tinned copper wire and the grid winding is of No. 20 or 22 s.w.g. polythene covered wire if available. Polythene insulant is preferable because it is not so lossy as PVC and thus damps the tuned circuit to a lesser extent.

The three trimmers C_{10}, C_{11} and C_{12} are mounted on a brass bracket which is fixed to the back of a three-position rotary switch. This switch should be in good condition and of robust design; it will be appreciated that the trimmers are across the tuned circuit of the oscillator and therefore the contacts of the switch have to pass appreciable r.f. current. It is desirable although not mandatory that the switch wafer be ceramic. The switch and trimmers are shown on this page.

Cathode Poisoning.—When the unit is switched to gramophone the r.f. stage and i.f. stages are left connected direct to the h.t. supply and a resistor (R_{44} 150 kΩ) is inserted into the oscillator feed. The reason for this is as follows: if certain valves are left for a period of time with their heaters on but with no h.t. the cathode becomes poisoned due to the building up of an interface on the cathode. So long as the valve is passing a small current the rate of build-up of this interface is slow.

Alignment.—Two methods of alignment are given, the first using a minimum of test gear and the second a somewhat more complicated procedure but one that will show up any discrepancies in the i.f. amplifier and discriminator and will also enable the receiver to be aligned more accurately. The latter is most important since for satisfactory operation it is necessary that the zero frequency voltage output from the discriminator be zero when the intermediate frequency lies in the centre of the i.f. passband.

For the first method a signal generator covering 10.7 Mc/s is required, also some form of valve voltmeter. There is no substitute for the generator but for those who do not possess a valve voltmeter the circuit shown in Fig. 6 will serve.

Switch on the receiver at least fifteen minutes before aligning, make sure that all the valves are drawing current and that the oscillator is oscillating. (If the oscillator is working correctly momentarily shorting its grid to ground will cause the valve to draw more current.) Join the junction of R_9, R_{10}, C_{16}, C_{17} to chassis, this will make the reactance valve inoperative.

The alignment may now be carried out. Set the signal generator to 10.7 Mc/s and connect it to the grid of V_4, adjust the output to about 0.1 volt. Connect the valve voltmeter to one side of the secondary of the discriminator and adjust L_{10} for maximum deflection. Disconnect the generator and connect it to the grid of V_3, adjust L_8 and L_9 for maximum deflection. As the coils come into tune it will be necessary to reduce the output from the generator, adjust this output to maintain approximately the same deflection obtained previously.

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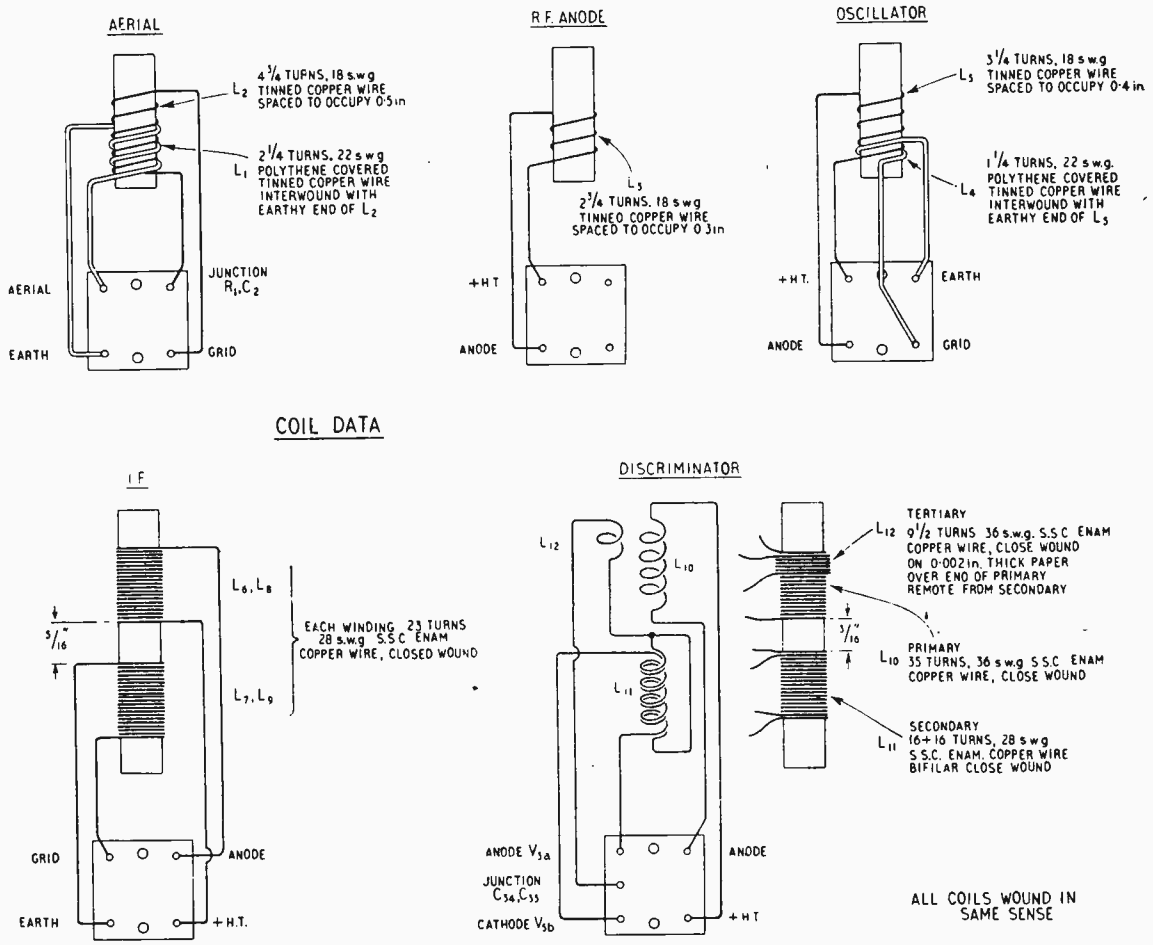
Disconnect the generator and reconnect it to the grid of V_2, adjust L_6 and L_7, turning down the output from the generator to maintain approximately the original deflection on the valve voltmeter. Now transfer the meter to the junction of R_{21} and C_{34} and adjust L_{11}; as the core is screwed into the coil the meter should first deflect in one direction, come down to zero and then deflect in the opposite direction. The correct position for the core is when the meter passes through zero. The i.f. and discriminator should now be aligned to 10.7 Mc/s.

Next connect an aerial (or the signal generator if it covers Band II) to the aerial input socket and the audio output to a power amplifier. Set the trimmer corresponding to the Home service so that about 5° of the vanes are meshing, turn the station select switch to "Home" and adjust the oscillator coil L_4, L_5 until the Home service is received. (The Home service is transmitted on the highest frequency from Wrotham, the frequencies of the three transmissions being: Home 93.5, Light 89.1 and Third 91.3 Mc/s.) Now set the station select switch to "Third" and adjust the corresponding trimmer until the Third programme is received. Connect the valve voltmeter between R_{17} and R_{18} and adjust the aerial coil L_1, L_2 and the anode coil L_3 for maximum deflection. It may be necessary to make small adjustments to the Third programme trimmer during this operation since tuning the r.f. stage affects the oscillator frequency. Having completed this, turn the station select switch to "Light" and adjust the corresponding trimmer until the Light programme is received. Finally with the valve voltmeter connected to the junction of R_{21},C_{34} adjust each of the trimmers for zero output (again the correct point is when the meter deflection passes through zero).

It now only remains to put the reactance valve into service but before doing so it is advisable to check that the error voltage developed from the discrimator goes positive with increase and negative with decrease of the intermediate frequency. To carry out this check connect the valve voltmeter to the junction of R_{21}, C_{34} and tune into a carrier, there should be zero reading on the meter. If now the hand is brought near to the oscillator circuit (adding capacity) the oscillator frequency will drop and this will result in a lower intermediate frequency; (the oscillator is working above the carrier) the valve voltmeter must register a *negative* voltage. Should a positive voltage be indicated the connections between the secondary of the discriminator



Winding details of the r.f. and i.f. coils used in the f.m. unit. L_1, L_2 and L_3 are wound on Aladdin formers Type PP5938 and enclosed in John Dale cans Type TV2. The i.f. and discriminator transformers are wound on Aladdin formers Type PP5937 and enclosed in Dale cans Type TV1. Cores: "purple" for L_1, L_2 and L_3, and "grey" for i.f. and discriminator.

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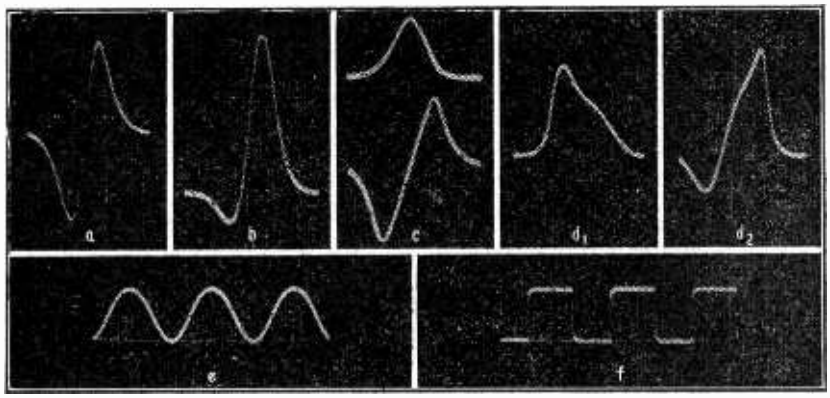

Fig. 7. Discriminator and i.f. amplifier oscillograms. (a) discriminator characteristic with 20 μV signal input to receiver: (b) with discriminator mistuned by ¼ turn of core: (c) discriminator and i.f. characteristics using double-beam oscilloscope: d_1 and d_2 effect of phase irregularities in i.f. amplifier: (e) and (f) discriminator output as a result of modulating oscillator by means of reactance valve and modulating frequency of 1,000 c/s, ±100 c/s deviation approximately, using sine and square-wave modulation.

and the two diodes should be reversed. Having performed this check the link connecting R_9, R_{10}, C_{16}, C_{17} may be removed, the reactance valve is now in operation.

The second method of alignment requires a signal generator covering 10.7 Mc/s and 87 Mc/s to 95 Mc/s, a valve voltmeter, an audio frequency generator and a single or double beam oscilloscope. Although not quite so convenient a B.B.C. carrier can be used for the signal in the 87 Mc/s to 95 Mc/s band and the 50-c/s heater supply can be used in place of the audio generator. The principle involved in this method is to use the audio source and the reactance valve to frequency modulate the input signal; the detected output from the discriminator and the modulation can then be applied to an oscilloscope in such a way as to display the combination of the i.f. phase/frequency and the discriminator amplitude/frequency characteristics. In addition the i.f. band-pass amplitude characteristic can also be displayed.

The variation of effective reactance with zero frequency input voltage to the reactance valve is reasonably linear over at least 500 kc/s and so an audio frequency sinusoidal voltage applied to the valve will produce a sinusoidal frequency modulation of the oscillator with peak deviation as great as ±250 kc/s with little distortion. Fig. 7e and f are actual oscillograms of the detected output from the discriminator as a result of modulating the oscillator by means of the reactance valve; the modulating frequency is 1,000 c/s and the peak-to-peak frequency deviation of the oscillator running at 100 Mc/s is about ±100 kc/s. The source of audio frequency is ideally an a.f. signal generator, but if this is not available the 6.3V heater supply, suitably attenuated, can be used. An audio voltage of between 100 and 300 mV is required.

To display these characteristics the zero frequency error voltage and the low-pass filter (R_{10}, C_{17}) are removed from the reactance valve and the audio source connected in their place, the source should have a d.c. path to chassis for the grid of the reactance valve. Temporarily disconnect C_{38}. If the oscillator is tuned to f_o and there is a carrier present of frequency f_c an intermediate frequency $f_0 - f_c$ will be produced which is frequency modulated by the audio source. (It does not matter if the carrier is already modulated). Applying the a.f. output to the Y-amplifier of an oscilloscope and using the audio source as the X sweep Fig. 7a will be displayed which is the overall i.f. phase/frequency and the discriminator amplitude/frequency characteristic. It may be necessary to place a simple r.c. phasing network in one of the two audio paths to correct for phase differences in these two paths.

Valve V_4 has no grid bias and so in the presence of a signal grid current will flow producing a voltage across the grid resistors R_{17} and R_{18}, this voltage is an indication of signal level and if applied to the Y-amplifier of the oscilloscope instead of the a.f. output the display produced will be the band-pass amplitude characteristic of the i.f. amplifier. Where a double-beam oscilloscope is available both the discriminator characteristic and the i.f. band-pass characteristic can be delineated at the same time, such a display is shown in Fig. 7c. This display will enable the discriminator to be accurately aligned and will also show up any phase irregularities within the i.f. amplifier (see Fig. 7d_1 and d_2).

If the receiver is carefully aligned the performance will be such that when switched on from cold the programme selected tunes in not far from the centre of the discriminator characteristic; drift, whilst the receiver is warming up, is small and is in any case directed towards the centre of the characteristic.

Appendix

Let C_p be a capacitor having a positive temperature coefficient of α_p.

Let C_n be a capacitor having a negative temperature coefficient of α_n

Now $C_p + C_n = 50$ pF

It can be shown

$$\frac{C_p \alpha_p + C_n \alpha_n}{C_p + C_n} = \alpha_t$$

where α_t is the required temperature coefficient.

Using a P100 capacitor ($\alpha_p = +100$ parts/million/°C) and an N740 capacitor ($\alpha_n = -470$ parts/million/°C)

C_n becomes 10.4 pF say 10 pF

C_p becomes 39.6 pF say 39 pF

So that the 50 pF tuning capacitor would become 10 pF P100 in parallel with 39 pF N470. The capacitors should be mounted inside the coil cans; the Erie non-insulated Ceramicons will be found small enough for this purpose.

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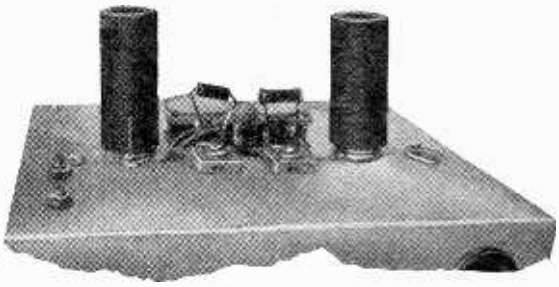
Selective Bandpass I.F. Amplifiers

Use of "Ferroxcube" Pot Cores in Conjunction with Negative Feedback

By J. S. BELROSE

The purpose of this article is to introduce designers to the use of "Ferroxcube" pot cores in selective bandpass filters. Designs have previously been described[1] for very narrow bandwidths and the author now gives details of filters suitable for radio telephone working in congested wavebands.



Experimental bandpass i.f. amplifier using Ferroxcube cores.

FOR a radio-telephone system a bandwidth of 3 kc/s is near to optimum. A receiver having this bandwidth would be suitable for the reception of single-sideband speech, or for reception of only one sideband of an ordinary double-sideband, amplitude-modulated carrier when adjacent channel interference is particularly severe. This article discusses the application of high-Q "Ferroxcube" pot cores in the design of a bandpass filter of bandwidth 3 kc/s. The response of the circuit approaches the ideal square-edged frequency response and will give performance superior to that of any circuit at present in use in communication receivers, other than the symmetrical bandpass crystal filter[2] and the electro-mechanical filter[3].

The method used here, to give a level pass-band frequency response and to sharpen the attenuation outside this range is to use frequency-selective negative feedback[4], [5]. Two parallel-tuned circuits are included in series between the cathode and earth, one tuned to the low side and one to the high side of the centre frequency of the pass band. These circuits provide negative feedback with considerable attenuation at the two resonate frequencies. Such a circuit is shown in Fig. 1.

Suppose the cathode circuits are designed to attenuate frequencies f_1 and f_2, which are symmetrically centred about f_0 the centre frequency of the pass band. The frequency response due to the feedback circuits is shown in Fig. 2. If overcoupled circuits are used in the anode of the anode of the amplifier, then, by proper design, the feedback response can be made to neutralize exactly the trough due the overcoupled circuits, and so a flat-topped response can be obtained with very steep "skirts."

Simplified Design Procedure—We will follow the procedure outlined by Sturley[5] and use his generalized selectivity curves for the cathode feedback and for the overcoupled circuit responses. For a flat overall pass band the shape of the cathode feedback curve must be the reverse of the coupled circuit curve, and the former should fit exactly over the latter in the pass band.

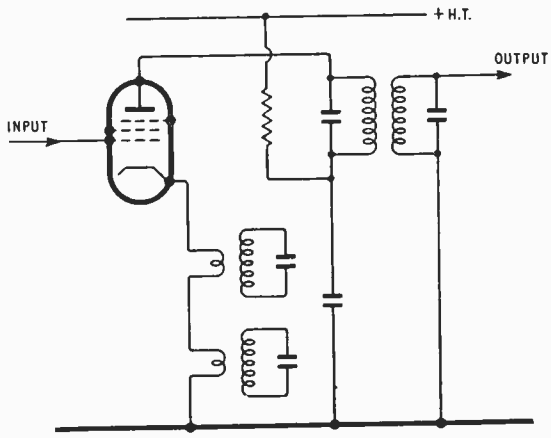
In our case we choose $f_0 = 100$ kc/s and we want a total bandwidth of 3 kc/s. Using Sturley's notation $\triangle f = 1.5$ kc/s (half the bandwidth). Suppose we design the maximum attenuation of the feedback circuits to be $\pm$ 3 kc/s about 100 kc/s (i.e., $f_1 =$ 97 kc/s and $f_2 =$ 103 kc/s). Our experience indicates that the maximum operating coil Q-factor we can easily obtain at 100 kc/s is about 180. We will design for this coil Q for the cathode coils.

To use the generalized curves of Sturley we need to calculate the parameter

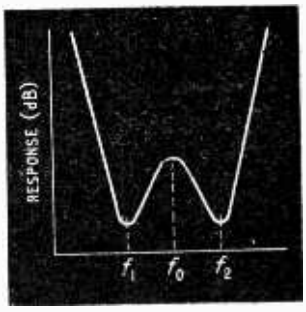
$$(Q\ F_1)^2 = \left[\frac{180 \times 2 \times 3}{100}\right]^2 = 117$$

$$\text{since } F_1 = \frac{2 \triangle f_1}{f_0} = \frac{2(f_0 - f_1)}{f_0}$$

The response curve for $(Q\ F_1)^2 = 117$ is therefore



Above:—Fig. 1. I.F. amplifier with cathode feedback.



Right:—Fig. 2. Frequency response due to feedback circuits.

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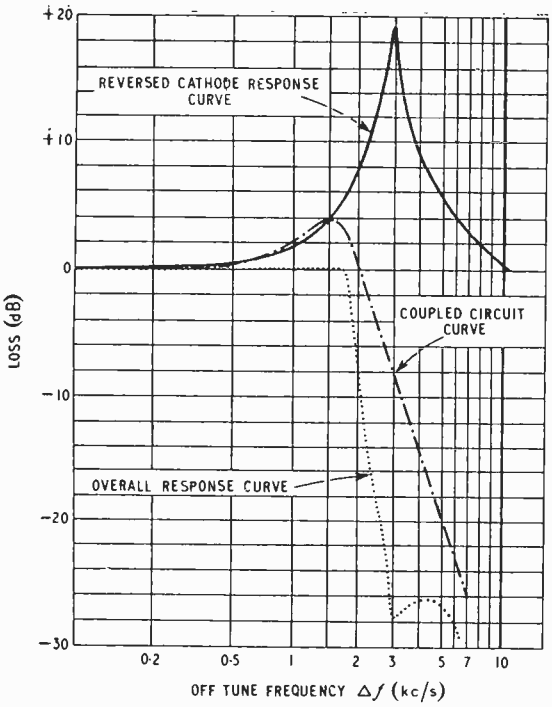


Fig. 3. Overall response for cathode feedback compensation.

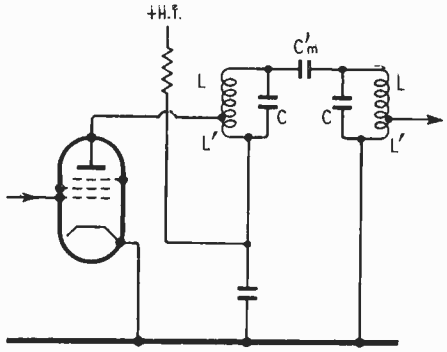
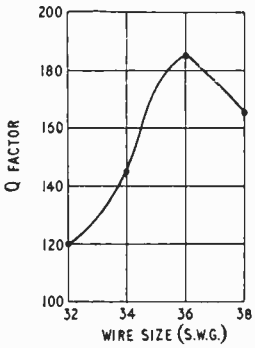


Fig. 5. Anode circuit.

Fig. 6. Variation of Q-factor with wire size.



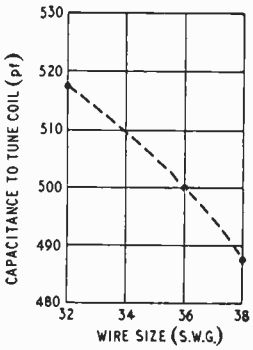


Fig. 7. Capacitance required to tune coil to 100 kc/s.

redrawn on tracing paper from Sturley's Fig. 7.47, p. 540 with the correct frequency scale but with the loss reversed. This curve which is given in Fig. 3 is placed on top of the set of generalized selectivity curves for overcoupled circuits (Sturley's Fig. 7.8, p. 453) and is moved along until it fits as nearly as possible over the coupled curve out to 1.5 kc/s. The most suitable curve is for $Qk = 3$ and we find that $\Delta f = 1$ intersects the coupled graph at $Q\,F = 2$. This fixes Q and k. For $QF = 2$ at $\Delta f = 1$, $Q = 100$ and $Qk = 3$, so $k = 0.03$

The overall response is obtained by plotting the difference (a dB scale) between the two curves. This is plotted also in Fig. 3.

Cathode Circuit.—The constants for the cathode circuit are given by

$$R_D = \frac{0.414\,(1 + Q^2F_1^2)}{2\,g_m}$$

For $g_m = 5.5$ mA/V, $R_D = 4440$ ohms.

The cathode tuned circuits are transformer coupled. For Ferroxcube pot cores $k \approx 1$, and so

Fig. 8. Complete circuit diagram of i.f. stage. With Mullard Type LA3 pot core, winding data are as follows:—Cathode transformers: primary 16 turns, secondary 191 turns, 36 s.w.g. enamelled wire, Q = 185. Anode transformers: 191 turns tapped at 88 turns, 36 s.w.g. enamelled wire, Q (shunted by 2 MΩ) = 125.

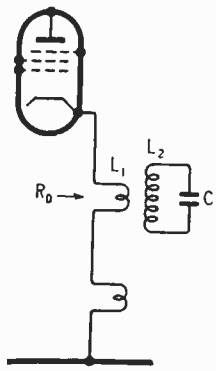
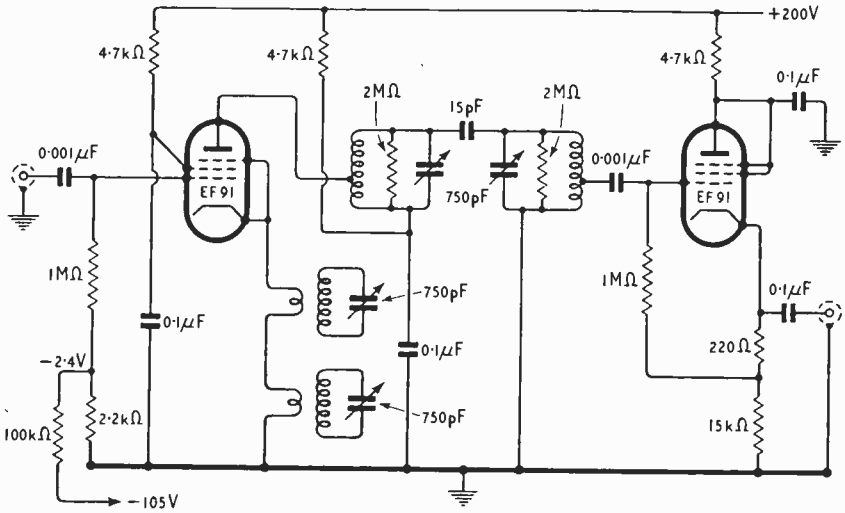


Fig. 4. Cathode circuit.



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$R_D = 2\pi f_0 Q L_1$ where L_1 = primary inductance, and the Q of the circuit is assumed to be that of the tuned secondary.

$$\text{Therefore } L_1 = \frac{4440}{2\pi \times 100 \times 10^3 \times 180} = 39.3\mu H$$

The secondary coil L_2 is arbitrarily chosen so that it will tune to 100 kc/s with 500 pF. Hence L_2 = 5.06 mH.

Ferroxcube pot cores type LA3 are recommended.* For these cores $n = 85\sqrt{L}$, where L = inductance (mH) and n = number of turns.

The cathode transformers then should have 191-turn secondaries with 17 turns primary wound over the secondary turns.

Anode Circuit.—The stage gain of the amplifier shown in Fig. 5 is

$$G = \left(\frac{L'}{L}\right) \frac{g_m k 2\pi f_0 L}{k^2 + \frac{1}{Q^2}}$$

where L′ = inductance of the tapped portion of the coil, L = total inductance, and the coupling between L′ and L is unity.

If G = 110, g_m = 5.5 mA/V, k = 0.03, Q = 100, then L′ = 1.08 mH.

Choose L = 5.06 mH, and the coils should have 191 turns tapped at 88 turns. The coupling capacitor $C'_m \approx kC$ = 15 pF.

Complete Circuit.—It is important to choose the correct wire size for optimum Q-factor. Several wire sizes were tried in order to obtain the desired Q-factors. Test coils of 191 turns were wound. The variation with wire size of the Q-factor, and the capacitance required to resonate the coil to 100 kc/s are shown in Figs. 6 and 7. There is clearly an optimum wire size for maximum Q. The coils used in the test amplifier built by the author were wound with 36 s.w.g. enamelled wire (do not use silk-covered wire, for the losses are considerably higher).

The circuit which was built for test is shown in Fig. 8. A cathode-follower output stage was used for convenience in testing. A Mullard EF91 valve was used and so biased that its g_m would be about 5.5 mA/V.

Method of Adjustment.—The circuit was aligned with a signal generator and a valve voltmeter. More elaborate instrumentation would allow the optimum response to be more easily obtained (i.e., a panoramic type of display with an oscilloscope and a sweep frequency signal generator).

With the cathode earthed, the anode circuits should be peaked at 101.5 kc/s. The other peak should be found about 98.5 kc/s. Trim until a symmetrical response is obtained, centred on 100 kc/s. Remove

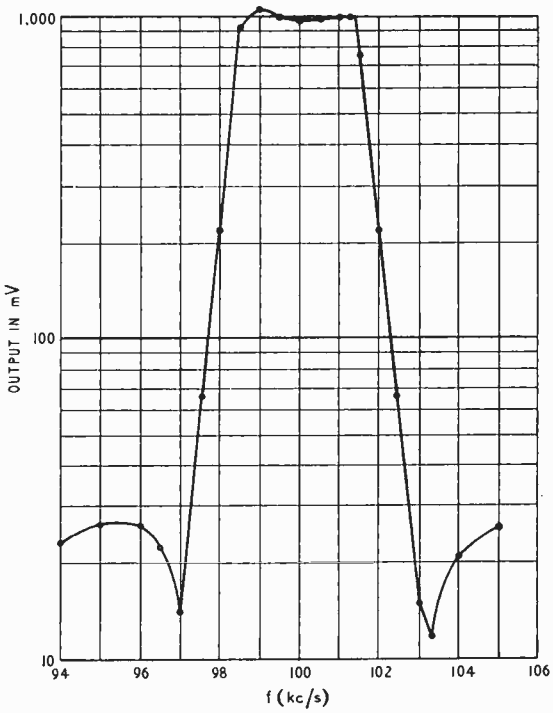

Fig. 9. Measured frequency response for cathode-feedback amplifier.

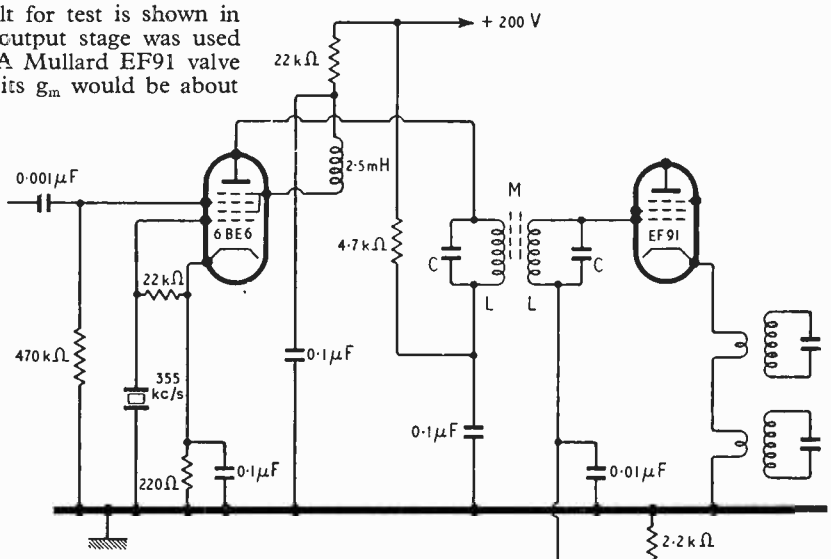

Fig. 10. Mixer circuit for use with a communications receiver with 455-kc/s i.f. Transformer details: L = 2.12 mH, Q ≈ 17, k ≈ 0.057 (pie-wound on moulded coil formers fitted with threaded iron-dust cores), C = 1200 pF.

*Manufactured by Philips' Industries, Eindhoven, and Ferroxcube Corporation of America. Obtainable in Great Britain through Mullard Components Division, in Canada through Rogers Majestic (Toronto) and in U.S.A. through Ferroxcube Corporation of America. The above is Mullard's type number. Philips' type number is D-25/17,5-10,50-IIIB3 (i.e. type 25 pot core, total height 17.5 mm, air gap 1 mm since the length of the ring is 11.5 mm, of Ferroxcube IIIB3 material). The Philips' type pot cores type D-25/17,5 have been superseded by D-25/16 and D-25/12 (i.e. the total height of the assembly is 16 and 12 mm rather than 17.5 mm). The advantage of these new pot cores for our application is that larger air gaps are available, 1.8 and 1.25 mm respectively for the IIIB3 types, and so a slightly improved temperature stability. The author has not used these new types. No doubt satisfactory Q-factors can be obtained with optimum wire-size/turns ratio.

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the earth connection to the cathode. Adjust the cathode circuits for maximum rejection of 103 and 97 kc/s. Take a frequency response of the circuit. If the response is not symmetrical with a flat top the tuning procedure must be repeated, perhaps slightly juggling the two rejection frequencies, until the desired response is obtained.

The response curve obtained with the circuit of Fig. 8 is shown in Fig. 9. The circuit is critical to adjust and must be carefully tuned if the curve shown in Fig. 9 is to be achieved. The response as shown was for an input of approximately 10 mV, so the voltage gain in the pass band is about 100. The anode coils were shunted, as shown, with 2 MΩ and the coil Q was 125, that is slightly higher than calculated. With the cathode earthed the gain at the centre frequency is 110 peaking to + 6.3 dB at the two peak frequencies. That is because of the higher Q's the circuit is more over-coupled than we calculated, but by carefully juggling the positions of the two reject frequencies a satisfactory response was obtained. The Q of the cathode transformers was not measured with the cathode current flowing through the primary turns. The Q of the secondary was 185.

Sturley[5] suggests that if a.g.c. is applied to the selective amplifier the circuit will function as an automatic variable bandwidth filter. With the circuit described here, however, it is absolutely necessary that the amplifier be operated at fixed bias, since any change in g_m or cathode current upsets the shape of the response. It is quite easy to obtain ridiculous lop-sided, lop-eared response curves.

Use of the Amplifier with a Conventional Receiver.—The circuitry necessary to use the amplifier in conjunction with a standard receiver of, say, 455 kc/s i.f. is straightforward. One point of warning, however, which should be obvious but can be overlooked: the mixer anode circuit should have a wide bandwidth so as not to spoil the flat top of the pass band amplifier. If commercially manufactured 100 kc/s transformers are used they will most certainly have to be modified, i.e., shunted with resistors and the coupling increased to give a bandwidth which is quite flat to 3 kc/s. A suggested circuit is given in Fig. 10. The values given for the anode transformer are suitable if home-constructed coils are used, they are designed for a bandwidth of 8 kc/s. The overall gain of the circuit as shown is about 500, so only a few millivolts of 455 kc/s signal is needed.

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[1] Belrose, J. S., "Ferroxcube cores and a High-Selectivity I.F. Amplifier," *Q.S.T.* April 1955, and *Q.S.T.* July 1956.

[2] Brailsford, J. D., "Generalized Curves for the Design of the Two Crystal Band Pass Filter," *Marconi Review*, *9*, 40, April-June 1946.

[3] George, R. W., "Electromechanical Filters for 100 kc/s Carrier and Sideband Selection," *Proc. I.R.E.*, *44*, 14 (Jan. 1956).

[4] Brailsford, J. D., "Frequency Selective Feedback Applied to Band Pass Amplifiers," *Marconi Review*, No. 68, p. 10, Jan.-Mar. 1938.

[5] Sturley, K. R., Radio Receiver Design, Pt. 1, p. 537, Chapman & Hall Ltd. (1953).

CLUB NEWS

Barnsley.—The first meeting of the Barnsley and District Amateur Radio Club, after the summer recess, will be the annual general meeting on September 14th. On the 28th W. Lee (G6LZ) will "review modern receivers." Meetings are held at 7.0 at the King George Hotel, Peel Street. Sec.: P. Carbutt (G2AFV), 33 Woodstock Road, Barnsley.

Birmingham.—At the meeting of the Slade Radio Society on August 31st, R. G. Hackel, of Joseph Lucas, Limited, will deal with the diagnosis, measurement and possible cures of interference from car electrical systems. On September 14th P. Huggins, of T.I. (Group Services), Limited, will speak on automation. Meetings are held at 7.45 at The Church House, High Street, Erdington, Birmingham 23. Sec.: C. N. Smart, 110 Woolmore Road, Erdington.

Birmingham.—The meetings of the Midlands Group of the British Amateur Television Club will restart on September 13th at 7.45 at the White Swan Inn, Edmund Street, Birmingham, and will meet on the second Thursday of each month. Sec.: F. J. Rawle (G3FHZ), 16 Kings Road, New Oscott, Sutton Coldfield, Warwicks.

Bournemouth.—The Bournemouth Amateur Radio Society is organizing a mobile/portable rally for September 16th at Stoney Cross Aerodrome, 7½ miles west of Southampton. Three control stations will be operating from 10.30—G2HIF on 2m, G3GYK on 80m and G3KYU on 160m. Those wishing to participate can obtain further details from the secretary. The Society meets on the first Friday of each month at 7.45 at the Cricketers' Arms Hotel, Windham Road, Bournemouth. Sec.: J. Ashford (G3KYU), 119 Petersfield Road, Boscombe East.

Newbury.—The Astronomer Royal, Dr. R. v. d. R. Woolley, will read a paper on "Astronomy and Cosmology" at the meeting of the Newbury and District Amateur Radio Society at 7.30 on September 28th at Elliot's Canteen, West Street, Newbury, Berks. Applications for tickets, which are free, should be sent to N.A.D.A.R.S., 83 Newtown Road, Newbury, Berks., enclosing a stamped addressed envelope.

South Shields.—At the town's annual flower show (August 24th to 26th) the South Shields and District Amateur Radio Club will operate a transmitter using the call GB3SFS. Reception reports will be welcome and certificates will be issued to the transmitter making the most contacts and the listener sending the most comprehensive report. The club meets regularly at Trinity House Social Centre, 134 Laygate Lane; the main meeting being on the last Wednesday of each month. Sec.: W. Dennell (G3ATA), 12 South Frederick Street, South Shields.

West Ruislip.—A radio club has been formed by the members of No. 114 Squadron, Air Training Corps, West Ruislip, Middlesex. Its transmitter, using the calls G3LAF and G4GB/A, will be on the air in the 40- and 80-metre bands on Sundays from 10.30 a.m. for two hours and on Tuesdays and Thursdays between 7.30 p.m. and 9.30 p.m. using phone and c.w. Reports will be welcome. Sec.: A. Morris, No. 114 Sqdn. A.T.C., No. 4 Maintenance Unit, West Ruislip, Middx.

Worthing.—The annual general meeting of the Worthing and District Amateur Radio Club will be held at 8.0 on September 10th at the Adult Education Centre, Union Place. Sec.: J. F. Wells, 37 Salvington Gardens, Worthing, Sussex.

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Too Old At — ?

AGE, HEARING AND "HI-FI"

By M. G. SCROGGIE, B.Sc., M.I.E.E.

HAVING for some time enjoyed the marvels of "ultra-linear" amplification, we may expect any time now to learn that the new electrostatic loudspeakers have brought us into the era of "ultrasonic hi-fi." Those of us who are not so young as we were, however, may be wondering why we should spend a lot of money on equipment for reproducing frequencies we cannot hear.

The fact that high frequencies are lost at an age when hearing is still good often dawns first when some member of the family complains of the loud 9-kc/s whistle that is now the normal accompaniment to medium-wave broadcast programmes after dark, and another cannot understand what he is talking about, being totally unable to hear it.

Fig. 1 shows the results of audiometer tests by C. C. Bunch on 353 hospital patients divided into age groups containing roughly equal numbers. The youngest group appears to have been taken as the reference level (0 dB). In the book "Hearing" by Stevens and Davis, from which this graph was taken, the authors mention that tests by H. C. Montgomery showed rather smaller losses with age—a discrepancy they attribute to hospital patients as a class being likely to suffer additional hearing loss as by-products of their ailments.

It occurred to me to compare these data with some measurements I had made on a few individuals (Fig. 2). They had been taken with a constant-output audio oscillator connected to moving-coil headphones through an attenuator having 5-dB steps. The victim was placed where the operator could not be seen, and asked to indicate by hand whether the signal was or was not heard. In this way guessing was eliminated. Care was taken, of course, to ensure that the switching was not only invisible but also silent—acoustically and electrically. The results were compensated for normal differences in acuity with frequency by means of the threshold-level Fletcher-Munson curve. Headphone characteristics were not compensated—a resonance is noticeable at 13 kc/s, for instance—but being the same for all a comparison of the curves is valid. The dB zero is quite arbitrary.

The numbers against the curves are the ages of the people tested. All had, as far as was known, normal hearing except the one aged 21, who had suffered an illness affecting the ear and—as might be expected from the graph—has some difficulty in following ordinary conversation. The measurements extended down to 40 c/s, but as there were no significant differences below 1 kc/s in any of the individuals—even the 21-year-old—those readings have been omitted.

Apart from the one clearly abnormal curve, these

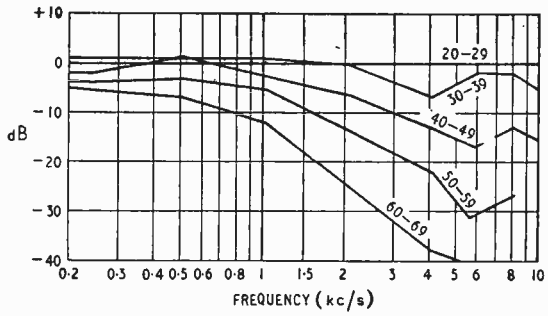

Fig. 1. Audiometer tests of various age groups.

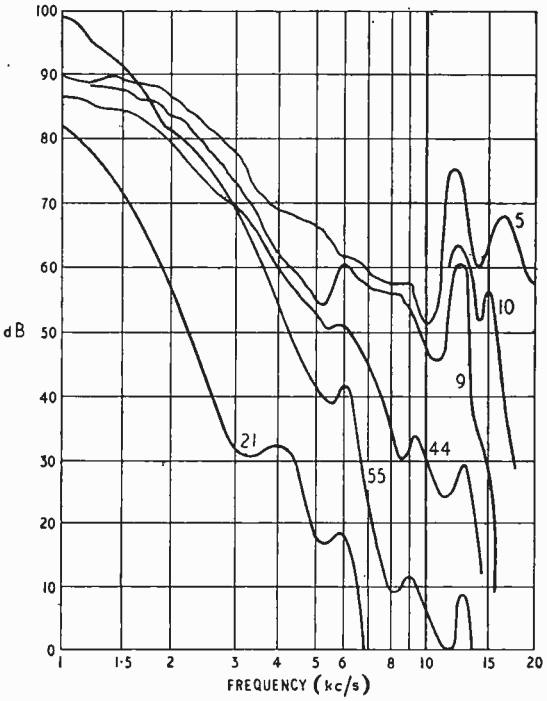

Fig. 2. Results of hearing tests made by the author on persons between 5 and 55 years of age. All except the 21-year-old were believed to have normal hearing.

results illustrate again the steady decline of high-frequency hearing with age. They might give the impression that Fig. 1 by no means overstates the decline, but the number of people represented by Fig. 2 is too small to tell; actually only two come within the age groups included in Fig. 1. The really interesting features of Fig. 2 are what it shows regarding the younger ages and higher frequencies—absent from all published data that have been seen. It appears that substantial loss of high-frequency hearing occurs in quite early childhood. And that this loss at first takes the form of a lowering of a sharp cut-off frequency rather than the increasingly downward slope above 1 kc/s that characterizes ages above 20.

The statements made elsewhere suggesting that loss begins in the late teens may have resulted from not extending tests to sufficiently early ages and high frequencies. I was fortunate in happening upon a

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5-year-old sufficiently intelligent and co-operative for the purpose; and in view of the precautions against fraud was frankly astonished to find no signs of cut-off even at 20 kc/s—well into the r.f. communication band!—and greatly regretted the absence of a quickly available extension of facilities to higher frequencies.

I still more deeply regret inability to possess once again hearing of this kind, for assessing the value of reproducers that work up to 20 kc/s or so. Unfortunately they seem to offer no advantage beyond the listener's cut-off, unless anyone is prepared to argue that the beating of supersonic components in the non-linearity of the ear produces audible components that add something worthwhile to fidelity. Personally I suspect that if anything does drop down in this way through the ceiling of audition it is more likely to reintroduce some non-linearity distortion that we would otherwise have been spared. But one has only to express almost any opinion on high-fidelity to provoke contradiction, so I expectantly leave it at that.

PICKING THE WINNERS

Random Number Generator for Premium Bonds

ON view at the Radio Show this year will be a version of the electronic machine known as ERNIE (Electronic Random Number Indicator Equipment) which is responsible for selecting the prize-winning numbers in the Government's new Premium Savings Bonds scheme. Its function is, of course, equivalent to the traditional method of drawing numbered counterfoils from a drum by hand. The numbers concerned will be made up of 9 digits and each of these digits will be generated separately by an independent piece of circuitry. This will safeguard the randomness of the numbers, in one respect, by ensuring that there is no correlation between individual digits of the 9-digit number.

Actually the second and third digits of the numbers will be alphabetical characters, but this merely means selecting randomly from a scale which is greater than the ten numerical characters. (That is, in the second digit position, where 23 alphabetical characters will be available; in the third position only ten characters will be used—the same as for numbers.) At the Radio Show the demonstration equipment will be generating only two of the digits.

The basic component of each digit-circuit is a cold-cathode gas discharge tube giving out a random noise waveform. This is followed by a clipping circuit which removes the low-amplitude fluctuations and leaves the remainder to be amplified and squared, giving an output of well-shaped pulses of constant amplitude. About 3,000 pulses are produced a second. The pulses are passed to a decade counter, which is started and stopped at regular intervals by a master timing pulse generator in such a way that the counting is done in periods of 160 milliseconds with gaps in between. At the end of each 160-msec period the number of pulses counted is read. This number might amount to something like, say, 487, and it is the digit in the units column, the 7, which is actually selected and indicated.

The counter is always started from the point at which it was left at the end of the previous 160-msec period. This gives a series of different starting points and ensures that the output digits will be more random (that is, equally likely to occur) than if, say, the counter were started from zero each time.

To guard against possible equipment failures each digit generator is duplicated. The two outputs from a pair of such circuits, each giving a different digit, are passed into a combining circuit which performs the *logical* operation of multiplying one by the other (but not actual *arithmetical* multiplication). This is done to avoid the possibility of a bias of periodicity appearing in a series of generated digits as a result of a fault in one of the gas discharge tubes. Multiplying a periodic series (from the bad tube) by a random series (from the good tube) always gives a random series as the product.

The digit outputs from the 9 combining circuits are transferred to stores, from which they are assembled, scanned and passed to teleprinters, together with fixed codes needed for the actual operation of the teleprinters—figure shift, letter shift, line feed, carriage return and spaces. The starting and stopping of the teleprinters (which are also duplicated) is done by the same master pulse generator which controls the counters. Circuits are incorporated for inhibiting random numbers above certain values, corresponding to ranges of Bonds not yet offered for sale, and these can be set before each draw. The equipment will also examine the first two digits of each number for the purpose of routing the numbers to appropriate teleprinter stations—each station being associated with a numerical register of a particular range of Bonds.

Amateur Television Book

"SELF-HELP" is the philosophy which seems to have inspired the amateur television transmitting enthusiasts throughout their difficult career. It has now been taken a stage further by Michael Barlow, a member of their organization*, in acting as his own publisher to produce his own book on amateur television. The work may not be up to the usual standards of professional publishing, but it contains a great deal of specialized information which certainly could not be obtained from any other single source: Starting off with a chapter on fundamentals, it passes on to the construction of flying-spot scanning apparatus, for both transparent and opaque subjects, then to mixers and modulators and finally to r.f. equipment. It also includes items on the B.A.T.C.*, their agreed transmission standards and the Post Office amateur television licence. A list of useful references is provided for those who wish to pursue the subject farther.

"An Introduction To Amateur Television Transmission," which contains 30 pages, can be obtained from Mr. Barlow at 10, Baddow Place Avenue, Gt. Baddow, Essex, price 3s 6d.

* The British Amateur Television Club.

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Improved Slide-back Valve Voltmeter

BY O. E. DZIERZYNSKI

Applications in Test and Control Apparatus

Conventional slide-back valve voltmeters are not much used nowadays for routine laboratory measurements in spite of their low input loss and independence of supply voltage variations. The reason is that two meters are required and concentration and skill are needed for accurate "zero" adjustment. The author shows how these disadvantages may be overcome and suggests uses for the improved design in test and control equipment.

AT least two indicating elements must be employed when taking measurements with, say, a bridge or a slide-back voltmeter; namely, an adjustable calibrated variable resistor, condenser or inductance, and a balance indicator. Let us see what sort of indicators are available: (1) moving-coil, (2) "magic eye," (3) neon indicator, (4) lamp or similar device actuated by a relay. Each of these indicators has some advantages and disadvantages, but as the instrument to be described had to be used for industrial control as well as measurement, a relay as indicator was chosen. Regarding the circuit itself, a slide-back voltmeter combined with a d.c. amplifier and output relay or neon indicator was developed. Before considering this circuit in detail, we will refresh our memory of the working of the slide-back valve voltmeter (s.b.v.) and explain why it is considered necessary to employ a d.c. amplifier.

Principle of the Conventional S.B.V.—In the circuit of Fig. 1 the d.c. bias is adjusted by the potential divider to obtain the same anode current with and without a.c. input; then providing that the voltage to be measured is high enough and the valve has a sharp enough cut-off, the measured positive peak voltage has a value v-v_0 when v and v_0 are the corresponding readings of the d.c. voltmeter, V.

The conventional s.b.v. measures the peak value of the signal, whereas we are generally interested in the mean or r.m.s. value. Other disadvantages are that two meters are required, and the accuracy is to some extent dependent on the valve cut-off characteristic and on the signal level.

Basic Circuit for Improved S.B.V.—In redesigning the voltmeter the first decision was to rectify the signal first and to derive a direct voltage representing its mean value. The next step was to replace the d.c. voltmeter, V, by a calibrated potentiometer supplied from a d.c. stabilized source V_1. In this way the actual bias voltage can be read directly from the potentiometer setting. Finally, the milliammeter in the anode circuit was replaced by a relay which is actuated from a certain threshold current upwards. The initial bias and the relay itself can be adjusted to cause movement of the armature from a given current upwards and with a determinable degree of accuracy.

Fig. 2 is a skeleton circuit of these new arrangements and it will be seen that a d.c. amplifier has been inserted between the input circuit and the relay. The need for this can be explained as follows. Relay RL has to indicate exactly the same total grid bias voltage before and after the signal is applied. Now if we assume that our smallest measured signal is, say, 1 volt (d.c.) and the required accuracy is ±5%, this would correspond to a change of anode

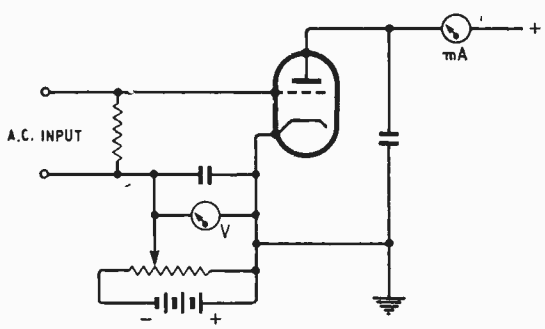

Fig. 1. Conventional slide-back valve voltmeter.

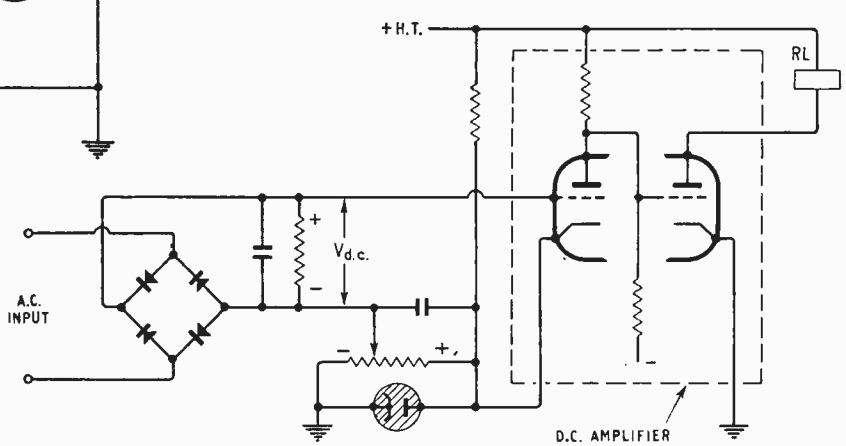

Fig. 2. With separate rectification and a d.c. amplifier a relay can be used as an accurate indicator.

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current of say 2mA±100μA—if only one triode is employed, without d.c. amplification. Consequently, if the relay has an initial current of, say, 4mA, the sensitivity of the armature going "on" and "off" has to be within limits ±100μA which represents only 2½% of 4mA. Unfortunately, in an ordinary relay this tolerance is much larger, and limits can be expected as high as ±10-30%.

Another factor to be taken into account is that relays usually have different "pull" and "release" currents and without certain circuitry modifications the figures quoted above might well be increased up to 60%.

The conclusion here is, that by amplification of the d.c. input signal all problems can be solved. Assuming that one stage of d.c. amplification would give us a gain of 20, we now have instead of ±100μA a change of ±2mA which represents ±50% of the initial relay current of 4mA. This means that 1 volt d.c. input can be measured within limits of accuracy of ±5%. Obviously, with larger signals the situation would improve—as 50mV (representing 5% of 1 volt) remains constant (as far as accuracy is concerned) for every signal. For instance, when applying −10 V d.c. to the grid and "sliding back" the potentiometer until the armature moves again, the accuracy of measurement would be 10 V ±50mV=10V±0.5%.

Circuit Stability and Accuracy.—Fig. 3 gives the final circuit. Before going into details it is important to analyse additional factors having influence on the stability and accuracy of measurements.

For reliable operation the current (given previously as 4mA) must remain constant within certain limits. Any drift from 4mA would involve additional error. Setting the limit for this error at, say, ±1% (total allowed ±6% of 1 V input), the permissible anode current drift would be 2/5=0.4mA.

Reducing drift of standing current is not a simple problem, as drift could result from several factors, as (a) variation of working voltage of stabilizer, (b) changing emission of both triodes, due to ageing, (c) fluctuation of emission (first triode particularly) due to heater voltage variations, (d) changing emission of each triode occurring very slowly during first 1-2 hours after switching on.

Let us analyse these factors. (a) Reference tubes types 85A1 and 150B2 were used, connected in series. 85A1 provides 85 volts, forming the negative part of the bias, V2; and also the positive and negative portions of the bias for V1 (developed across r_1, r_2 and r_3 respectively). Maximum percentage fluctuation of working voltage in this valve is 0.2%, i.e., 170 mV, and it can be calculated from the ECC81 characteristics that this would affect anode current up to approximately 0.35 MA. On the other hand, every change of the stabilized 85V would affect simultaneously the grid bias of V1 which is of total value about −1.2V (negative value in cathode −2.2V

(*Continued on page* 443)

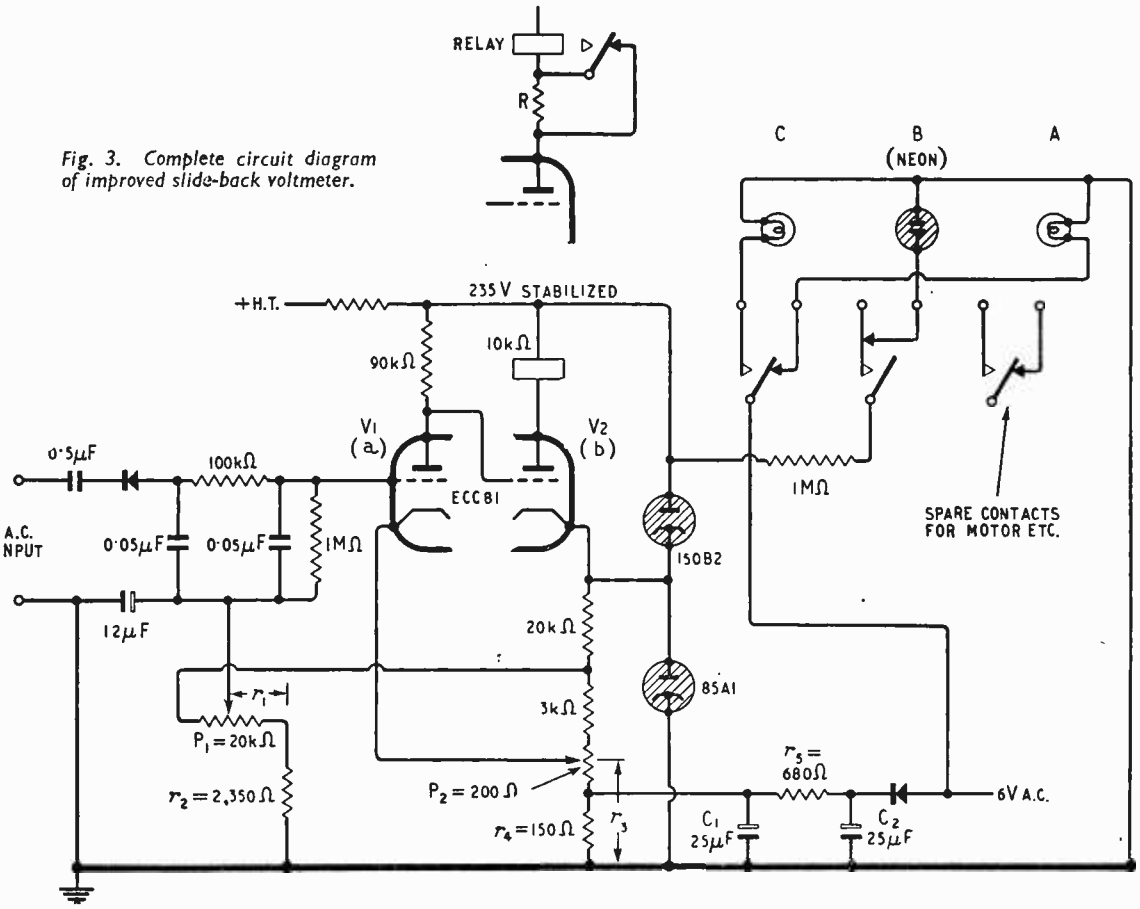

Fig. 3. Complete circuit diagram of improved slide-back voltmeter.

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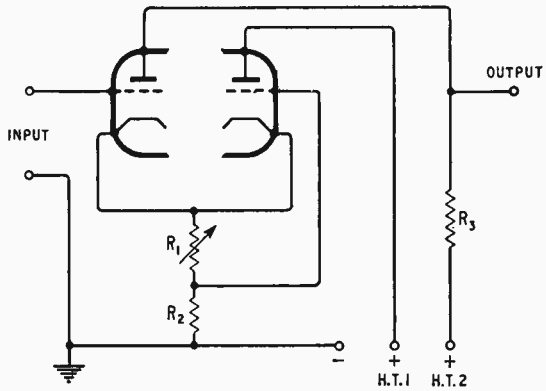

Fig. 4. Circuit for compensating long-term drift of emission.

opposed by positive portion on r_1, r_2 which is 1V). Corresponding fluctuation would be $\frac{1.2}{85} \times 170 = 2.4$ mV, and this after amplification, say 20 times, would produce 48 mV to the grid V2 in opposite sense to the 170 mV. As a result, the grid of V2 will receive 170-48 = 122 mV and the current change would be only $0.35 \times \frac{122}{170} = 0.25$ mA.

We must remember here that all this is assuming no-signal conditions. With the presence of a signal, say −10V, after balancing relay to a current of 4 mA, the positive portion of V1 bias would be 10-1.2 = 8.8V. This 8.8V could vary from stabilizer fluctuation by $170 \times \frac{8.8}{85} = 17.6$ mV, and to the grid V2 could be delivered as a total of $-(17.6 \times 20) + 170 = -80$ mV. In effect the current change would be only $0.35 \times \frac{80}{170} = 0.16$ mA. From this it is apparent that working voltage fluctuations affect accuracy most when the smallest signal is being measured; with increasing signal level error is reduced until the balance condition between positive and negative biasing voltages in the grid circuits of V1 and V2 respectively is obtained.

Anode current fluctuations are here 0.25-0 mA and well within the required limits 0.4 mA.

(b) Changing emission of triodes has an obvious effect on the anode current drift, but this occurs gradually and accuracy of measurement is not affected if, every time the instrument is used, the initial current conditions are checked and adjusted (potr. P_2).

(c) Fluctuation of emission due to heater voltage variation has the largest effect on anode current drift. It was found that current changes proportionally to mains voltage at a rate of 1.5 mA per volt a.c. To minimize this effect two alternative methods could be used: to stabilize heater voltage or to design compensating methods by applying additional bias varying proportionately to mains variations and with amplitude and phase properly chosen. To stabilize heater voltage, constant-voltage transformers could be employed or heaters connected in series with conventional barretters. Special transformers are rather expensive and barretters are not recommended on account of the excessive heat developed in a normal-sized cabinet.

The compensating method was found very effective, simple and not expensive. A fraction of the negative portion of the bias of V1 ($r_4 = 150\Omega$) is derived from the heater supply through a small rectifier. The output is so adjusted, that any change of heater voltage produces an additional bias voltage in the grid circuit of V1, entirely compensating any change of anode current in V2 due to varying emission. Rather large smoothing condensers C_1, C_2 are chosen to make the time constant of the rectified output large, as variations of current due to mains fluctuation do not occur rapidly but with a certain delay. With proper adjustment of the ratio r_4/r_5, compensation can be made very accurate and mains voltage variations between 200-250V did not cause drift of more than ±2% (of 4 mA).

(d) Slow drift of emission is of the order of 50μA in valve ECC81, consequently the anode voltage drift in the first section of the valve will be around 400 mV, which is equivalent to a drift of 15 mV in the input circuit, representing only 1.5% of minimum measured voltage (1V). Obviously the effect of (d) can be disregarded in our circuit. However, if any reader would like to reduce this drift to improve accuracy, the circuit of Fig. 4 could be employed. In this case the first section of the ECC81 (V1) has to be replaced by a double triode with identical characteristics and a value of R_2 equal to $1/g_2$ where g_2 is the mutual conductance of the right-hand half.

Output Relay Circuit.—The output relay, giving indication of identical voltage (and current) conditions in the circuit, has to fulfil certain requirements regarding winding and type of contacts to be employed. Before measurement, the current should be checked, by adjusting P_2, to set for the moment when the armature of the relay is on the point of moving. Depending now on which direction the potentiometer is moved, some backlash effect will be experienced. This can be reduced by inserting a resistor R (Fig. 3) in series with the winding, R being short-circuited when the relay is "off" and opened while it is "on." In this way the actuating currents for pull and release are compensated. Another way to improve this action is to adjust the gap between armature and core.

The next problem concerns the indicator itself. Three indicating lights are employed. Lamp A signals when the relay is "off," B when the relay armature is in motion, and C when it is in the "on" position. Most important for our purposes is the neon indicator B, which produces only a flash of light. Indicators A and C (pilot bulbs) are helpful in determining the setting of the slide-back potentiometer P_1. For example, let us assume that a certain measurement has to be taken. After switching on the instrument and allowing a few seconds for "warming up," one of the indicators A or C will be on; by adjusting P_2 a change-over from A to C (or *vice versa*) will be found, and P_2 must be left in a position close to this change-over, i.e., to the flash in B. After applying the unknown voltage to the input terminal, indicator C will be "on" and we have to turn P_1 now in a clockwise direction until the change-over from C to A occurs (indicated by flash in B). A reading of the input voltage can then be taken from the calibrated scale of P_1.

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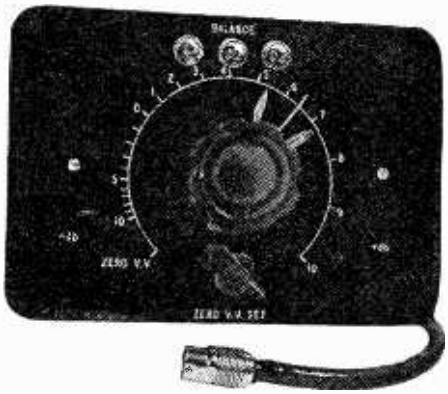

Improved slide-back voltmeter with scale calibrated in dB for use as an a.f. level indicator

Indicating System without Relay.—If the instrument is to be used only for measuring purposes and no further actuating action is necessary (such as switching heavy-duty mechanical contacts, etc.), it could be advantageous to dispense with the relay. This could be achieved by employing an additional double triode in a supplementary output circuit (Fig. 5 (a)). Here three neon indicators are used. Neon B is inserted between the two anodes of output triodes V3 and V4 and lights up only for given biasing conditions. This is a result of the fact that irrespectively of the signal d.c. voltage applied to the grids the biasing voltages of each section are opposed to each other for approximately 2 V (batteries b_1, b_2).

While increasing signal voltage V_s (positive), valve V3, having the grid more positive, will start to conduct before V4 and a difference of potential will appear between the anodes of V3 and V4 lighting up the neon. Still further increasing the positive signal, this difference will reach a maximum and then decrease, as now valve V4 will start to conduct as well. Fig. 5 (b) shows how the d.c. voltage V depends on the positive signal on grid V for different biasing conditions. A bias difference of 2 V gives optimum conditions when the neon is lit up quite firmly and discrimination of output signal amplitude is within ±2 V. Neons A and C indicate voltages respectively higher and lower than the voltage setting of the slide-back potentiometer.

Applications

Level Indicator.—The most important use of the complete instrument is in replacing the conventional d.c. microammeter bridge rectifier employed in a sensitive valve voltmeter. The photograph shows a level indicator in which the potentiometer scale is calibrated in decibels as in this case the differences in certain a.f. levels had to be measured and registered.

For this purpose two addition "limit" pointers are employed. Several frequencies are played back from a tape recorder and their relative response should be within, say, 6 dB (±3 dB). When the reference frequency (1,000 c/s) is first reproduced, the s.b.v. control with all three pointers closed together is set to, say, 0 dB level and the latter is adjusted by the volume control in the tape recorder ("balance" neon on). Other frequencies might give different levels which have to be followed by turning the s.b.v. knob to keep the "balance" neon alight. While doing so, the right-hand loose pointer would be setting limits for higher levels and the left would be doing so for lower. Finally, when all frequencies are played back these two limiting pointers, by indicating maximum and minimum of level, tell us if the response is within required limits (6 dB). Using an ordinary meter indicator, these readings must be memorized, but here maximum and minimum of levels are recorded. Accuracy of setting can be improved considerably by replacing manual control by automatic setting. In this case the potentiometer can be driven by a small reversible motor actuated from the relay described before, and the neon indicators in such a system would have only auxiliary importance.

Supply Voltage Controllers.—The basic circuit of an electronic supply voltage regulator is given in Fig. 6 (a) in which a very similar circuit to the s.b.v. is employed. Unit A has

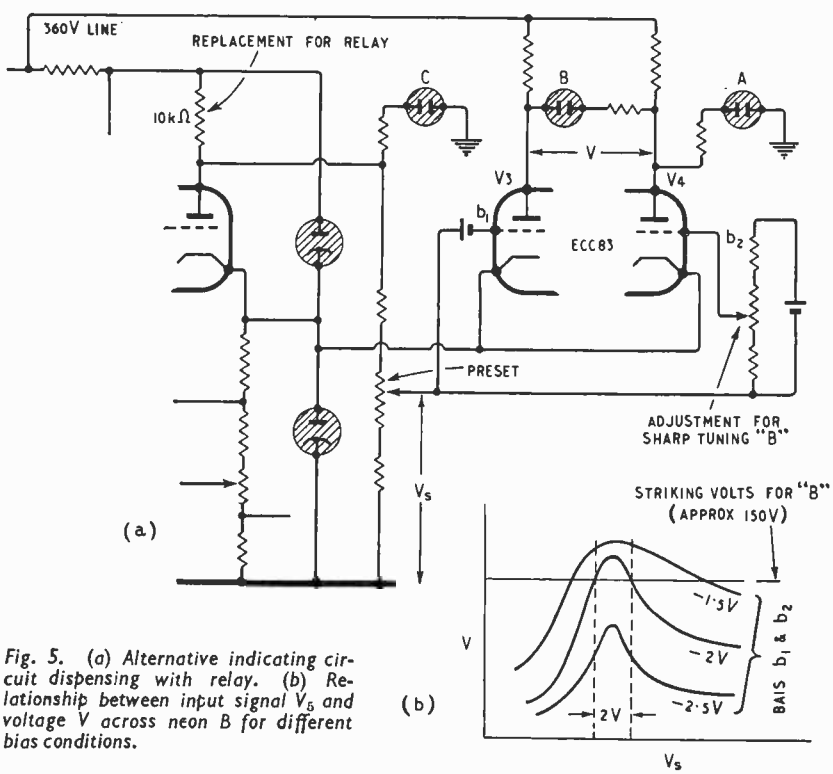

Fig. 5. (a) Alternative indicating circuit dispensing with relay. (b) Relationship between input signal V_s and voltage V across neon B for different bias conditions.

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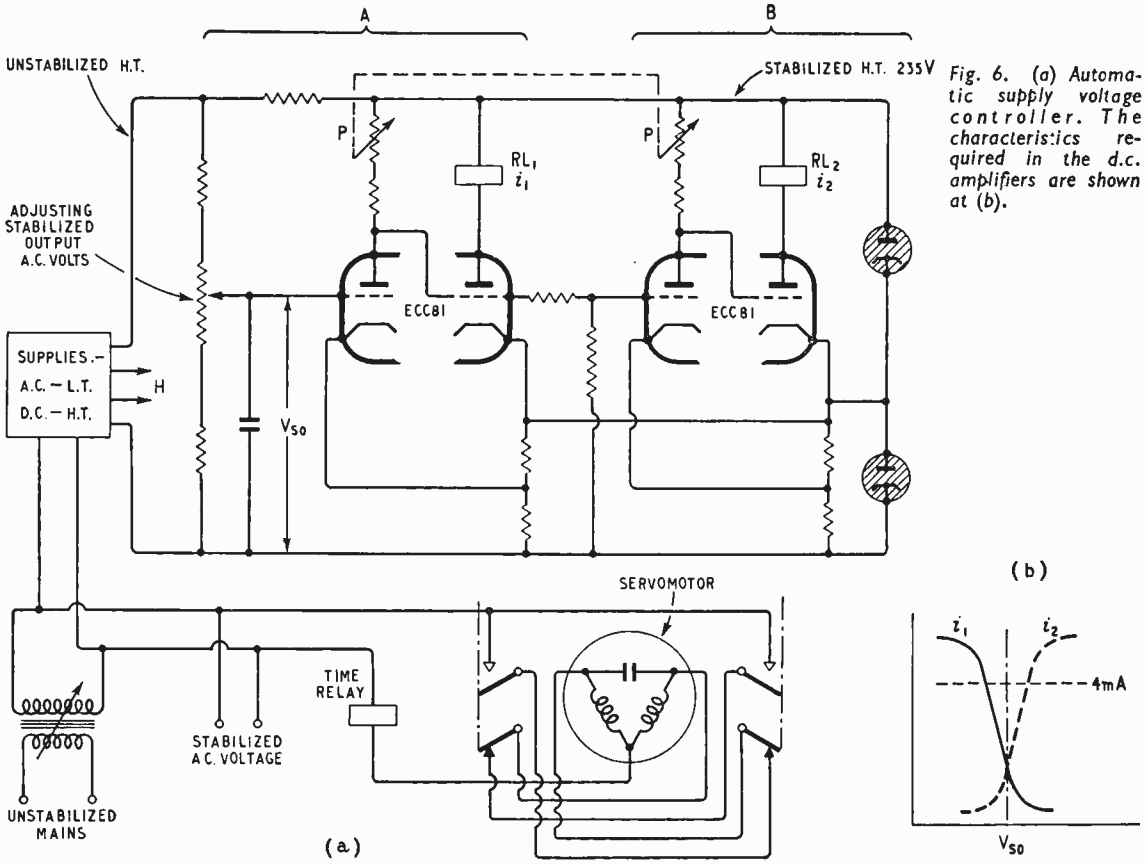

Fig. 6. (a) Automatic supply voltage controller. The characteristics required in the d.c. amplifiers are shown at (b).

a d.c. amplifier characteristic as shown in the full-line curve at (b) and unit B must have a similar characteristic but with reversed phase. Biasing conditions and anode voltages of the left-hand sections of the double triodes are so adjusted that for only one input voltage V_{so} are the anode currents in both relays low enough not to actuate the armatures. Every change of V_{so} outside limits ± 1 per cent will actuate RL_1 or RL_2 and would switch on the reversible servomotor which rotates the control of the supplying "Variac" transformer. If the mains voltage rises (V_{so} would rise, RL_2 actuate; curve i_2) the servomotor will turn the "Variac" in the direction to reduce output voltage—and *vice versa.*

By setting the control P, different a.c. mains outputs can be obtained, ranging between 190 and 260 V.

Selective Calling for Ground-to-Air Communication

A SELECTIVE calling device for use with long-range pilot-operated h.f. radio-telephone equipment now in use for air-to-ground communication has been developed by Motorola. Known as Secal, its purpose is to relieve the pilot of the need for maintaining a continuous radio watch.

Calling the aircraft is effected by a ground-station unit which applies coded audio tones of short duration to the transmitter. In the aircraft these tones are fed into the airborne Secal unit which responds only to the particular combination for which it is set up and then sets in operation a flashing light and chiming sound to attract the pilot's attention.

Some changes in existing ground-station procedure may be necessary as with Secal in use only Secal-equipped ground stations can call an aircraft direct and those not fitted may have either to make contact through a station so fitted or by previously arranged schedules.

As for technical details of the system, 12 different tones between 312.6 c/s and 922.2 c/s, with tolerances held at $\pm 0.15\%$ are used. Each call consists of two tones transmitted simultaneously for one second with an interval of 0.2 sec followed by a further two tones for one second. Each Secal-fitted aircraft is allotted a permanent four-letter (equivalent to four tone) call.

The ground-station Secal equipment consists of a small control unit having four twelve-position switches each marked "A" to "M" (I being omitted) and on these the code letters of the aircraft to be called is set up by the ground controller.

A push button then initiates the call and a lamp is illuminated which is repeated on other control units at the ground station to warn other operators that the Secal equipment is in use on any particular channel. It is usual to provide as many Secal control units as there are radio channels likely to be used simultaneously at any one ground station.

It is stated in the May, 1956, issue of the *I.A.L. News*, the magazine of International Airadio from which this description is taken, that a Secal-equipped aircraft can often be contacted by a ground station much quicker than would otherwise be possible, for when signals are weak the call might be difficult to hear on a busy channel whereas the calling device will respond immediately.

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Wide-Band Linear R.F. Amplifier

Results of Tests to Check Performance of Amplifier and Filter

By B. F. DAVIES,* A.M.I.E.E.

(*Concluded from page 378 of the previous issue*)

SUMMARY OF AMPLIFIER CHARACTERISTICS

Nominal Gain: 15 dB
Frequency Coverage: 150 kc/s to to 25 Mc/s.
Band-stop Filters: 400–535 kc/s: 1.6–3.8 Mc/s.
Inlet: 75Ω coaxial.
Outlets: 4 x 75Ω coaxial.
Cross-modulation Limit: 0.35 V
1st I.M. Criterion: 50 mV } Input
2nd I.M. Criterion : 25 mV

Linearity of a high order is necessary in an amplifier covering all broadcast bands, if inter- and cross-modulation products are to be kept down. This article gives the results of measurements on an amplifier (described in the previous issue) which was designed as part of a ship's communal aerial system. The filter used to suppress currents induced by the ship's transmitter must also meet a stringent specification

MEASURED between 75-Ω impedances, the actual gain of the amplifier from input to any output was 14.6 dB, while the frequency response, which includes that of the filter, was as given in Fig. 9. Without the anode corrector coils in circuit, the 25-Mc/s response would have been some 6 dB down.

To make measurements utilizing two signals, the test circuit of Fig. 10 was set up. It was found necessary to have the isolating resistances in each signal-generator output in order to minimize reaction between the generators. Tests were commenced by first checking that, with the amplifier omitted and the generators delivering levels greater than that required for actual measurements, no unwanted inter- or cross-modulation effects could be detected on the receiver. The amplifier was then inserted, together with an attenuator to bring the voltage at the receiver back to the same level, and the measurement carried out.

The basis of the cross-modulation (X.M.) test was to find the level of a 30% modulated signal at the input that would produce modulation, 20 dB down (3% modulation level), on a small unmodulated carrier. A reference signal of 5μV at 1.4 Mc/s, 30% modulated, was applied to the input (the necessary allowance being made in all cases for the input test circuit loss), the receiver was tuned in and a reference output noted. The modulation was then switched off and the carrier increased to 50μV (+20 dB). The level of the other generator, 30% modulated, was then increased until the same reference output was read on the receiver output meter. The large interfering signal was, of course, kept off 1.4 Mc/s. From the results quoted, an input signal of 0.35 V could be handled. This means that if a filter is used which has an attenuation of 40 dB, the aerial input volts within the M.F. and I.F. bands could be as high as 35 volts.

At high frequencies the maximum input leve falls about 3 dB but at 20 to 25 Mc/s high voltages on the aerial are likely to be a rare occurrence and, from available statistics, do not exceed 5 V when the ship's transmitter is working in the 22-Mc/s band. Should an H.F. band filter be used in the installation, the attenuation requirements would therefore not be so stringent as for the filters for the M.F. and I.F. bands. It should be remembered, however, that in the short-wave broadcast bands H.F. transmissions are made by other ships which will induce voltages into the aerial which will pass unattenuated to the amplifier input. The H.F. band filtering unit could not be relied upon to rectify this, as in practice it would only be switched into the aerial circuit by the radio operator during his own H.F. transmissions. The main reason for keeping the H.F. band filter out of circuit as often as possible is to avoid attenuation of some broadcasting bands, which conflict with the communication bands and also to avoid introducing a general insertion loss into the aerial circuit, which would be the case if several conventional-type filters were permanently inserted. Nevertheless, induced voltages greater than 0.35 V, caused by such transmissions from neighbouring ships, are extremely unlikely and immunity from cross modulation on all carriers can largely be guaranteed.

Test Requirements

When we come to testing for both forms of intermodulation, we must first consider how the test results will be interpreted. The 1st I.M. has been shown to be proportional to the product of the two carrier strengths, pq. As the same result could be obtained with carriers of equal strength ($p = q$) or with one very strong carrier ($p \gg q$), it is evident that the total input voltage applied to the amplifier ($p + q$) will not be indicative of the signal-handling capabilities where intermodulation is concerned. Fig. 11 shows how for a constant pq (neither carrier being considered modulated) the total voltage, as

* Formerly with the Marconi International Marine Communication Company Limited.

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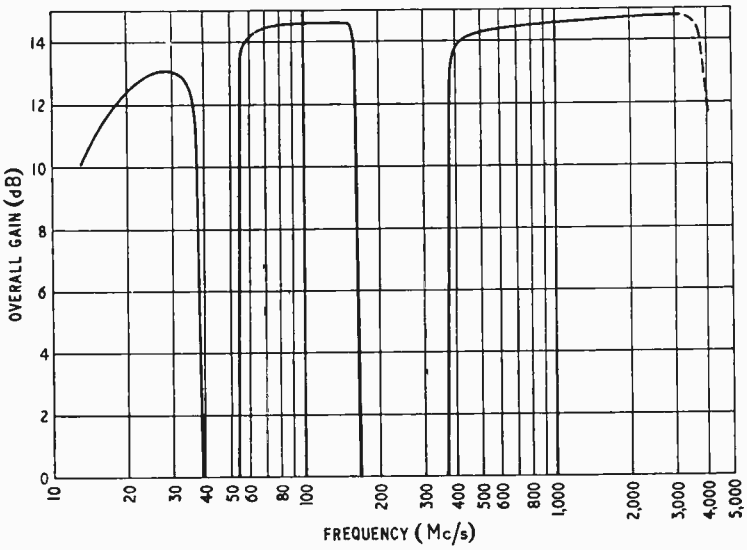

Fig. 9. Measured response of amplifier and filter.

would be measured on a peak reading r.f. voltmeter, varies with p. To establish a criterion, we can use $\sqrt{pq}$, which for two equal carriers will be equal to the level of each individual carrier. If, now, the tests are carried out by injecting the two signals simultaneously at the same level, we need only quote the signal level of either carrier entering the amplifier to ascertain the I.M. handling capabilities. With two equal carriers ($p = q$) for a given I.M. criterion voltage, the input level will be twice the criterion voltage. With only one carrier of high level (p), the total voltage level that can be accepted by the amplifier can, to a good approximation, exceed the criterion figure by the amount that the next highest carrier (q) is below the criterion figure.

The tests were based on ascertaining the I.M. criterion level at which the intermodulation product at ($\alpha + \beta$) or ($\alpha - \beta$) was equal to a carrier level of 5μV, a level which for entertainment purposes on a broadcast receiver would be considered an insignificant signal. It should be remembered that the noise field in the close vicinity of a ship, due to electrical machinery, is if possible kept down to 5μV/metre which demands signal strengths of 50μV/metre to obtain signal to noise ratios of 20 dB. On test a 5μV signal from one signal generator at 1.4 Mc/s, 30% modulated, was injected into the amplifier and the receiver set to a given reference output. The two generators, one of which was modulated 30%, were then set to 0.65 Mc/s and 0.75 Mc/s so that ($\alpha + \beta$) would correspond to 1.4 Mc/s and the levels increased simultaneously until the same reference output was obtained again. The push-pull balance control in this instance is used to obtain optimum results as it is capable of minimizing the 2nd harmonic distortion. Figures obtained for the I.M. criterion ranged from 50mV to 100mV according to the valves used. At 20 Mc/s and above, the results deteriorate due to the reduction in the linearization factor. For ($\alpha - \beta$) = 1.4 Mc/s where $\beta = 22$ Mc/s and $\alpha = 23.4$ Mc/s, the criterion figure was 25 mV. The question arises as to what happens when, say, α is at 22 Mc/s and β at 13 Mc/s, and the I.M. product is at 9 Mc/s. A series of tests have shown that, providing one of the carriers in question is at a sufficiently high frequency for the linearization factor to suffer, the I.M. criterion figure will be affected. Tables II and III show that 1st I.M. products, derived from frequencies in the common s.w. broadcast bands, can in some cases fall within the same s.w. bands. The greatest liability to I.M. from such causes

TABLE II

S.W. Broadcasting Bands					
49 m	5.95	—	6.20	Mc/s	*a*
41 m	7.15	—	7.30	,,	*b*
31 m	9.50	—	9.775	,,	*c*
25 m	11.70	—	11.975	,,	*d*
19 m	15.10	—	15.45	,,	*e*
16 m	17.70	—	17.90	,,	*f*
13 m	21.45	—	21.75	,,	*g*

TABLE III

(1)	(2)
a + *d*	*f*
a + *e*	*g*
c + *d*	*g*
b − *a*	M.W.
d − *a*	*a*
e − *c*	*a*
f − *a*	*d*
g − *e*	*a*
g − *d*	*e*

(1) Bands containing interfering signals.
(2) Band in which 1st I.M. product falls.

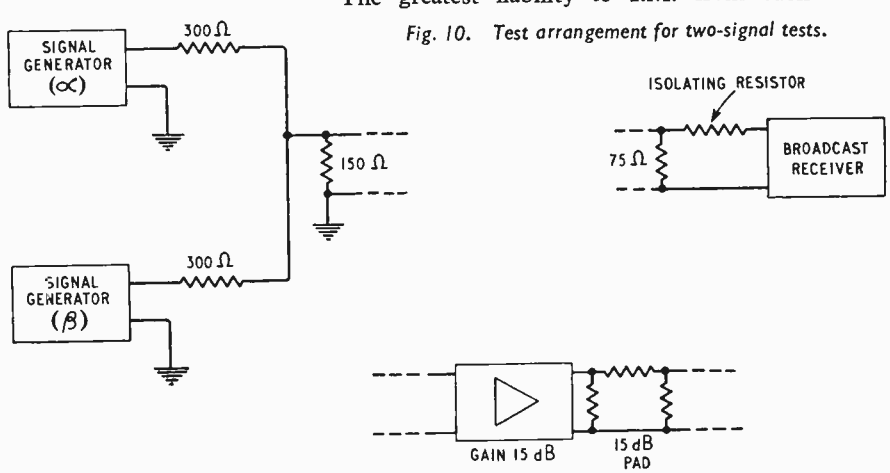

Fig. 10. Test arrangement for two-signal tests.

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arises when there is a strong signal in the 13-metre band. Such interference from s.w. broadcasting bands is by no means the only interference due to 1st I.M. that could exist, there being many high-powered transmissions on communication frequencies, but such a consideration does serve to illustrate the possibilities of interference.

Second-order Intermodulation

When we come to the question of the 2nd order I.M., we must remember that the intermodulation term is proportional to p^2q or pq^2. Fig 12 shows how the total input level $(p + q)$ will vary as p is varied for a constant value of the product term. It will be seen that for the I.M. terms $(2\alpha + \beta)$ and $(2\alpha - \beta)$, where $k = p^2q$, the signal handling capacity $(p + q)$ rises more steeply below a certain minimum value: for $(2\beta + \alpha)$ and $(2\beta - \alpha)$ when $k = pq^2$, the rise below the minimum value is less. The converse case will apply for variations of q. Now in the 1st I.M. tests the criterion level corresponded to the minimum value of $(p + q)$, but in this case we can see from the graph that if we have $p = q$, it does not give a minimum for either sum of the 2nd I.M. terms. Actually, taking p^2q or $pq^2 = 1$, the two minima shown, for $p = 0.63$ or 1.26, give $(p + q) = 1.89$, while if $p = 1$, $(p + q) = 2$; a difference of only 6%. We can, therefore, adopt the same method of expressing a 2nd I.M. criterion value for the input handling capacity as we used before with very little error, namely applying p and q of the same amplitude during test.

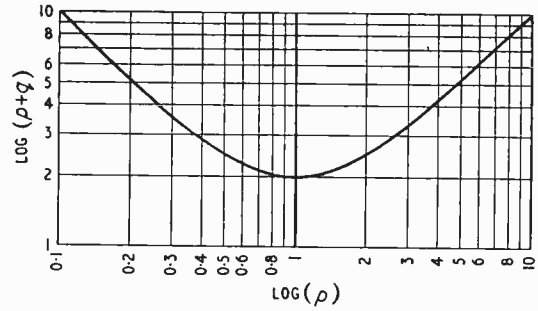

Fig. 11. Variation, for a given 1st I.M. product, of total peak input voltage (p + q) with p for the condition pq = 1.

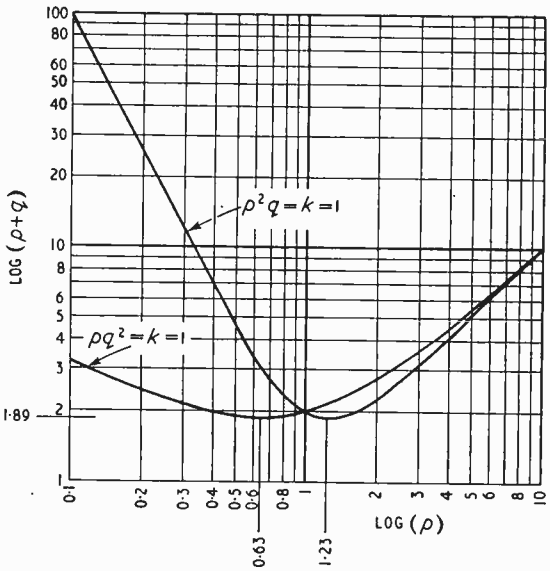

Fig. 12. Total input level for a given 2nd I.M. product.

The other point that has to be considered is that if the 30% modulation is applied to the p carrier, for I.M. terms proportional to p^2q, we will have twice the modulation detected by the receiver on the I.M. carrier compared with having 30% modulation on the q carrier. By taking the worst possibility, we must ensure that the carrier representing p^2 or q^2 on test, is the one that is modulated.

The 2nd I.M. criterion level was found to be 50 mV, falling off only slightly above 20 Mc/s. Throughout the test, the reference frequency of 1.4 Mc/s was used for convenience, but there is no reason why other frequencies cannot be used, when similar results would again be obtained.

A point worthy of note is that 2nd I.M. products derived from $(2\alpha - \beta)$ can be important if α and β are close together, as would be the case of two signals in the same s.w. broadcast band. The $(2\alpha - \beta)$ product would then probably fall within the same band. This also applies to the M.W. band and in Table IV a few cases in the European area are shown where two signals could interfere with a third. On the practical side, the case of two 50 mV signals is hardly worth considering, since it is likely to arise only in some districts lying inland between transmitters.

Another interesting point concerning inter-modulation arises when one high-level input signal is present which is just at the cross-modulation level. From the final amplifier characteristics it is evident that the cross-modulation limit is 17 dB and 23 dB above the 1st and 2nd I.M. criterion limits respectively. Now, for the 1st I.M. case, if $\sqrt{pq} = 50$ mV and p is + 17 dB on 50 mV, then q is −17 dB on 50 mV, or 7.1 mV, and with no other signals above this figure no 1st I.M. would be present. In practice, a few signals, especially when near port, may exceed this figure. For the 2nd I.M. case, we will have two figures, using the criterion level of 25 mV for the

TABLE IV
2nd I.M. PRODUCTS IN THE M.W. BROADCAST BAND

Interfering Stations		Station Experiencing Interference
(kc/s)	(kc/s)	(kc/s)
1376 Lille	1439 Luxembourg	1313 Stavanger
1151 B.B.C. Stagshaw	1088 B.B.C. Droitwich	1214 B.B.C. Brookman's Park
1007 Hilversum	926 Brussels	1088 B.B.C. Droitwich
908 B.B.C. Brookman's Park	1070 Paris	746 Hilversum
908 B.B.C. Brookman's Park	692 B.B.C. Moorside Edge	1124 Brussels
863 Paris	620 Brussels	1124 Brussels
746 Hilversum	620 Brussels	872 A.F.N. W. Germany

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level of the smaller signal. When the input signal of 0.35 V corresponds to p^2, the small signal q must be − 34dB on 25 mV, or 0.5 mV, but when the small signal corresponds to q^2 it need only be − 8.5 dB on 25 mV or 9.4mV, to prevent 2nd I.M. occurring under these conditions.

Conclusion

The main requirement of an aerial amplifier and its associated distribution network is that it should operate with the minimum of attention and to all intents and purposes should be as reliable as the proverbial "piece of wire." Freedom from cross-modulation not only minimizes interference but ensures that secrecy is maintained in the transmission of messages from the ship. No aerial distribution system can be considered satisfactory if passengers' radio telephone calls are to be heard on every station on the cabin receivers!

The wide-band amplifier that has been developed has necessarily been a compromise, but experience has already indicated that it is meeting all requirements.

TRANSISTORS

AN INTRODUCTION FOR BEGINNERS

BY "CATHODE RAY"

To obtain, as it were, a transfer ticket from valves to transistors one must get to know something about their differences. The currents in valves are made of electrons emitted from a heated cathode and are controlled in a clear space made of vacuum. In transistors, the counterpart of the vacuum is a crystal of germanium or silicon, which is certainly not a clear space but a sort of latticework of atoms joined together by co-valent bonds.* However, there is any amount of room throughout this latticework for currents to flow, just as there is in solid metal. But ideally there are no currents, because all the electrons are busy holding the crystal structure together. Free electrons can be introduced into the crystal by mixing with it a very small proportion of an element such as antimony that has one electron per atom too many to employ in the structure. These loose electrons make the crystal conduct; but because the "impurity" atoms are comparatively few the free electrons are far less numerous than in a metal and so the material (called *n*-type because the free electrons are negative charges) is only a semi-conductor. However, the resistance of the pieces that are commonly used is quite small because they are short and fat.

If on the other hand the crystal contains an impurity element such as indium, with one electron per atom too few, the shortage of an electron constitutes a "hole," which appears to move from place to place by successively borrowing electrons from other atoms. Because a hole is equivalent to a positive charge, material with holes is called *p*-type.

Crystal rectifiers and transistors—or at least those classified as junction types—are made up of pieces of crystal divided into *n* and *p* regions.

We saw last month how it is that a simple *p-n* junction works as a rectifier. If you were new to it you may have found the explanation rather complicated even though in fact it was simplified by leaving out some of the details. If so, you may be glad of a still simpler way of looking at it. Fig. 1(a) shows how current can consist either of negative charges flowing from − to + or positive charges from + to −. Or, of course, both at once. When a thermionic diode is connected as at (b), current can flow because the heated cathode is an emitter of electrons, which are negative charges. But when connected as at (c) there is no current, because the anode does not emit electrons; neither does the cathode emit positive charges. But in a *p-n* junction connected *p* to + (d) current flows because the *n* region is an emitter of electrons *and* the *p* region an emitter of holes, which are positive charges. When reversed (e) both regions emit the wrong charges, so there is no current.

One of the complications, which we did go into in some detail, is intrinsic conduction. The crystalline elements germanium and silicon in which *p* and *n* regions can be formed by impurities are also liable to have their own atoms broken up by heat or light into hole and electron pairs. Since their own atoms predominate in both *p* and *n* regions, these hole and electron pairs are formed regardless of *p* and *n* distinctions, and so there is two-way current through the material regardless of polarity. This effect, as regards a *p-n* rectifier, can be represented as a conductor shunted across it, which is generally a nuisance. Light can easily be excluded by an opaque covering, but unfortunately the amount of heat at ordinary temperatures is sufficient to give germanium an appreciable amount of intrinsic conductivity, and at the sort of temperature one can easily get in electronic equipment it is enough to reduce the efficiency very seriously. This is the chief snag about germanium devices, and the reason why research departments are pressing on with silicon, which can go to a considerably higher

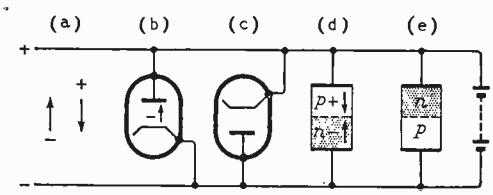

Fig. 1. Current can flow as electrons to positive and/or "holes" to negative (a). In a thermionic valve the cathode emits electrons, so current can flow if it is negative (b) but not if it is positive (c). A p-n junction emits both electrons and holes simultaneously and current can flow if it is connected as at (d) but not if as at (e).

* For the information of newcomers to whom these bonds are less familiar than the premium kind, see the last two instalments, on "Semi-Conductors."

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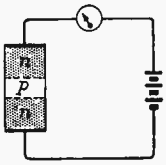

Fig. 2. Because one junction is bound to be in reverse, a double junction cannot pass much current either way.

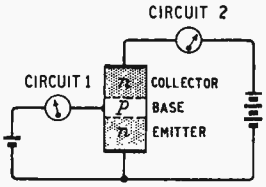

Fig. 3. But if electrons are brought into the p region thus, they are readily attracted further by a positive potential.

temperature before its intrinsic conductivity becomes comparable with its impurity conductivity. (Silicon, however, has its own particular snags.)

Those were the main findings of the last two months, leading to crystal rectification. Germanium and silicon rectifiers are still making tremendous progress for both signals and power. And not only up our particular street; the future policy of British Railways has been based largely on the extremely high efficiency of crystal rectifiers.

But transistors are our concern, so let us go right on to triple combinations of *p* and *n* materials, or double junctions if you prefer. There are two varieties, corresponding to the two varieties of sandwich chocolate provided by a well-known maker—milk-plain-milk or plain-milk-plain. They are—the semi-conductor junctions, I mean; not the chocolate—designated *n-p-n* and *p-n-p*. The chocolate analogy is quite a good one, for it too is a single slab containing three regions of essentially the same material but differing in the proportions of ingredients. The differences in the germanium are however too small to detect by chemical analysis, let alone visual inspection. So one must take the maker's word for it, or investigate electrically. Most if not all of the junction transistors obtainable in this country are *p-n-p* type, but except for a reversal of sign the *n-p-n* type is the same in principle and rather easier to compare with a triode valve.

If an e.m.f. is applied from end to end, as in Fig. 2, the circuit consists of two rectifiers in series opposition, and it is obvious that except for the (normally small) " leakage " current due to intrinsic conduction no current can flow whatever the polarity of the e.m.f. A quick glance back at Fig. 1 tells us that when connected as shown nearly the whole of the total potential difference between the ends occurs across the boundary between the upper *n* region and the *p*, for those two regions make a rectifier in reverse and therefore a very high resistance, whereas the *p* and lower *n* are a forward rectifier, with a very low resistance.

So far the utility of the arrangement is not conspicuous. The next step (Fig. 3) is to give the *p* layer a small positive bias. This biases the lower rectifier in the forward direction and allows current to flow in circuit 1. That is precisely what one would expect, but what would hardly have been expected is that (A) the amount of current is much less than if only that circuit had been present, and (B) a relatively large current flows in circuit 2.

The resemblance between this *n-p-n* junction transistor and a triode valve now begins to appear. The chief difference is that the transistor is basically a current amplifier rather than a voltage amplifier. The upper *n* region is analogous to a triode's anode; the lower *n* region to the cathode; and the *p* region to the grid-controlled space in between. But they are not called by these names. Instead of the anode there is the *collector*; and instead of the cathode, the *emitter*. Both these names would be quite appropriate in a triode. But the middle electrode in the transistor is called the *base*, which seems curiously inappropriate. The reason for it, which will appear later, is historical rather than functional.

Before going on to consider the behaviour of this type of transistor in more detail, you are entitled to expect some explanation for the surprising outcome of the Fig. 3 experiment. How is it that current can flow freely the " wrong " way through the upper rectifier? The answer to this question comes if we recall why it is that current doesn't normally flow this way through a *p-n* junction. It is because the only free current carriers present in substantial quantities in a *p* region are holes, which are repelled rather than attracted by a positive potential on the *n* region—the collector in this case. But the emitter, which is purposely made a high-impurity *n* region, has vast numbers of free electrons, and when the base is made positive they swarm across the frontier into it. In other words, the emitter emits electrons into an electron vacuum. There, they naturally respond to the attraction of the positive collector, much as electrons emitted into the vacuum of a valve by the cathode go to the anode.

Transistor Characteristics

If the grid of a valve were made positive like the base in this transistor, some of the electrons would be attracted to it, causing grid current. And so it is in the transistor. But the proportion that does so is relatively small because the base is made very thin —only one or two thousandths of an inch, or even less. In a transistor there is a third alternative for the electrons: they can combine with the holes in the base and so disappear. But because of the thinness of the base, and also because the number of holes in it is further restricted by making it of low-impurity material, the proportion lost in this way is very small.

The voltage amplification in a valve is related to the amplification factor μ, which is the change of anode voltage caused in a constant-current anode circuit by one volt change of grid potential. In a transistor the ratio of change of collector current (at constant voltage) to the change of base current causing it is denoted by α_{cb} or α', and may be anything from 10 to 100 or more according to type.

For an explanation of the *p-n-p* transistor, the same treatise will do again if " negative " and " positive " are interchanged, and also " holes " and " electrons."

There is no corresponding inverted kind of valve, with a hole-emitter as the anode, so in push-pull circuits it is necessary to use phase-reversing transformers or other devices at input and output. This is not necessary with transistors if matched-characteristic *n-p-n* and *p-n-p* types are available. The fact that transistors of either polarity can be produced is a unique feature which could come in very useful.

Although the picture of an *n-p-n* junction transistor

(*Continued on page 451*)

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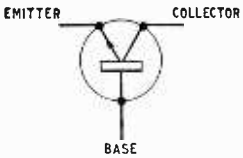

Fig. 4. This now well-known transistor symbol replaces that in Figs. 2 and 3 in circuit diagrams. It indicates a n-p-n type; for a p-n-p type the arrow is reversed. The circular envelope is optional.

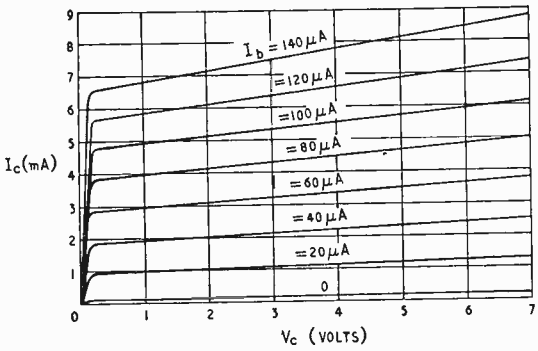

Fig. 5. Collector characteristic curves for n-p-n junction transistor in earthed-emitter arrangement, with base current as parameter.

in Figs. 2 and 3 could be used for circuit diagrams generally, in fact it is not. A great many different symbols have been suggested—as regular *Wireless World* readers must have noticed—but the only one that is generally used is shown in Fig. 4. The direction of the arrow head marking the emitter indicates the direction of current flow (which according to convention is opposite to the direction of electron flow) so Fig. 4 represents a *n-p-n* transistor. With the arrow reversed it would signify *p-n-p*.

Of the various valve characteristic curves that can be drawn, the most generally useful are those relating anode current to anode voltage for various values of grid voltage. The corresponding transistor curves are those relating collector current to collector voltage for various values of base *current*. Fig. 5 shows a typical set of these for a *n-p-n* transistor, which is easier to compare with a valve than a *p-n-p* transistor because the polarities are the same; but to tell the truth the curves actually belong to a Mullard OC71 which is a *p-n-p* type, and have been adapted simply by reversing the signs.

The most immediately obvious feature about the curves is that they are "pentode type." The rapid rise from zero, followed by an almost horizontal main run indicating high output resistance, is typical. But when one examines them more closely, the differences are no less striking than the superficial resemblance. Perhaps the biggest surprise is the voltage scale. Whereas a pentode may still be straightening out at 100 anode volts, the transistor is right on the job at 0.2 V! So efficient working is possible with only a single dry cell (1.4 V) as "h.t." A thermionic valve begins by needing at the very least 35 mW to heat the cathode (even in the latest and most economical sub-miniature types) before it starts to do any work, whereas a transistor can give back in useful work a substantial proportion of a power supply totalling a fraction of a milliwatt.

Next, the linearity of the curves compares favourably with that of pentodes, and the evenness of their spacing right down to cut-off compares more than favourably with the tendency of pentode curves to close up steadily as the grid bias is increased. The transistor linearity is admittedly somewhat marred by the tendency for the slopes of the lines to vary, so that a load line drawn athwart them cuts them at unequal intervals, but it still looks better than a pentode. While the voltage scale is so much smaller, the output current scale is not unlike that for low-power pentodes, so the near-flatness of the lines doesn't mean such a high output resistance as for pentodes. The resistance represented by the steep rise is phenomenally small—of the order of 20 Ω.

Lastly, instead of the control being exercised by grid voltages from zero downwards it is by base currents from zero upwards. The idea of current input takes a little getting used to, but the fact that the zero-bias line more or less coincides with cut-off is rather convenient. The input impedance—as one would expect, seeing that it is a forward rectifier—is very non-linear, and, since input current control is as linear as Fig. 5 shows, it follows that input voltage control would be non-linear.

High-Frequency Effect

As we all know, the performance of a valve falls off at very high frequencies, for several reasons. One is that the interelectrode capacitances form a low-impedance shunt across the couplings. Another is that the time taken by the electrons to cross the space inside the valve is not negligible in comparison with a signal cycle, and the phase shift so introduced causes loss. Both these effects have their counterparts in transistors. Although the boundary area between base and collector in the low-power junction transistors now available is smaller than the electrode areas in valves, the thickness is less still, so the capacitance is usually somewhat greater. And although the distance across the base is very small, the speed of the electrons is far slower than in a valve, and holes are slower still. Junction transistors, in

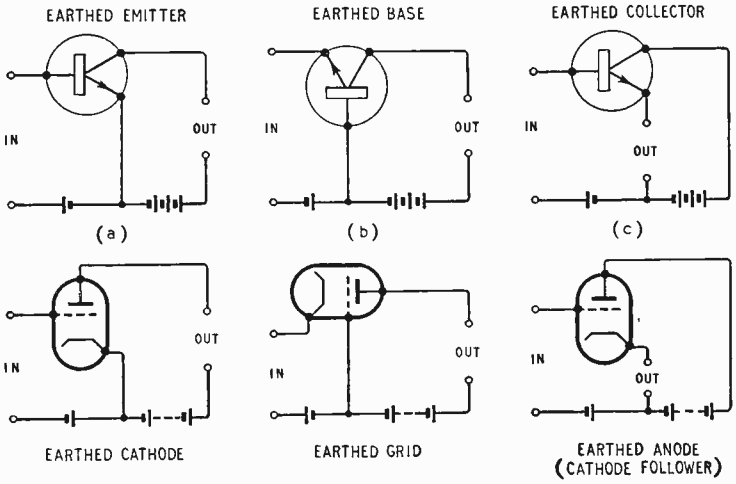

Fig. 6. The three basic transistor arrangements, with their valve analogues.

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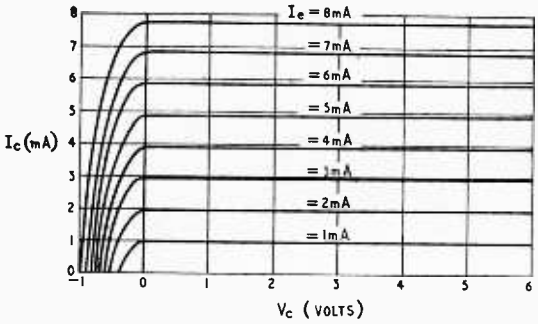


Fig. 7. Collector characteristic curves for same transistor as Fig. 5 in earthed-base arrangement, with emitter current as parameter.

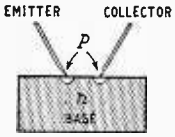


Fig. 8. Construction of point-contact transistor, which is obviously the basis for the standard circuit-diagram symbol for a transistor, Fig. 4.

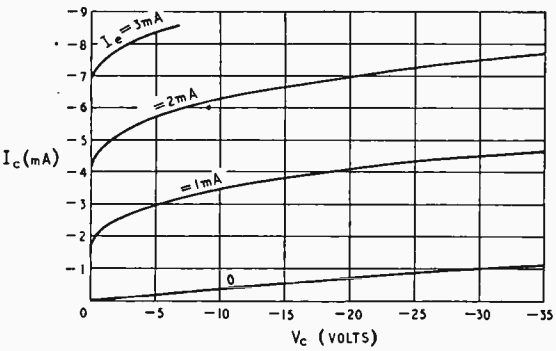
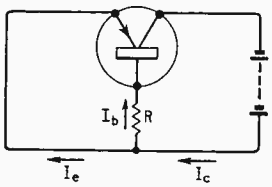


Fig. 9. Collector characteristic curves of point-contact transistor, corresponding to those of Fig. 7 for junction type.

Fig. 10. The use of a base resistor in a point transistor circuit is liable to cause trouble unless precautions are taken to limit collector current.



fact, are for the most part pretty poor at even moderately high frequencies, and at present are used almost entirely for audio.

Although the usual method of using valves is from grid to anode, with cathode common to both and more or less earthed, there are two other schemes: earthed grid, and earthed anode (usually known as cathode follower). Similarly, there are two transistor schemes besides the earthed-emitter one already suggested by Figs. 3 and 5; they are of course the earthed base and earthed collector (Fig. 6). The valve analogy runs through them all. For instance, the earthed-collector transistor has (like the cathode follower) the highest input resistance and lowest output resistance of the three, and its voltage gain is just short of 1. And the earthed-base (like the earthed-grid valve) has a very low input resistance, and—though for rather different reasons—is suitable for amplifying at higher frequencies than the earthed emitter or cathode. Its performance is also rather less dependent on the somewhat wide variations of characteristics for which unfortunately transistors are noted.

For comparison with Fig. 5, Fig. 7 shows the output characteristics of the same transistor with emitter input (i.e., earthed base). Note the really high output resistance; the collector current is almost entirely unaffected by collector voltage from zero upwards, and a small negative voltage is needed to stop it. Then there is the comparatively high emitter current needed to control the output current; this means a low input resistance. The change of I_c caused by each milliamp change in I_e is in fact rather less than 1 mA, and the ratio of the two (which is the current amplification of this transistor arrangement) has been given the symbol α. It is easy to find the relationship between α' and α from the fact that $I_e = I_c + I_b$. Let a small change in any of the currents be denoted by small i. Then

$$\alpha = \frac{i_c}{i_e} = \frac{i_c}{i_c + i_b} = \frac{i_c/i_b}{i_c/i_b + i_b/i_b} = \frac{\alpha'}{\alpha' + 1}$$

This fractional current amplification looks as if it would strongly discourage use of earthed-base transistors, unless one remembers that the input resistance of this arrangement (being a forward-biased rectifier) is only a few ohms whereas Fig. 7 shows that the output resistance is vast—actually it is of the order of a megohm. So the voltage amplification—and hence the power gain—can be quite large, though not so large as with the earthed-emitter arrangement. But at high frequencies it may well overtake it.

You may be thinking there is something fishy about beginning with a quantity α' and then discovering α. And you would be right. Because people first started using valves in earthed-cathode circuits, they didn't have to start using transistors in earthed-emitter circuits. As it happened, for a reason that will become clearer in a moment or two, they started with earthed-base, invented α, then discovered that transistors could be used with earthed emitters, and hence the need for another amplification symbol, which became α'.

Another fishy feature (in my order of presentation) is the circuit symbol, Fig. 4, which by no stretch of imagination resembles a junction transistor. That, of course, is because the original transistor was not a junction transistor but a thing that really did (and still does) resemble Fig. 4—the point-contact transistor. It is simply a small block of germanium, usually *n* type, with two fine wire points pressing on it a few thousandths of an inch apart. I have introduced transistors out of historical order for the reason that, whereas a plausible explanation of how the junction type works is available, even the latest expositions of the point-contact type seem to me to be elaborate ways of saying that how it works is unknown.

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However a few things can be said. A point-contact transistor has to be "formed" by passing pulses of current through the contacts. It seems that this converts the *n*-type material around the points into *p*-type (Fig. 8), which is in accordance with the fact that the thing has the polarity of a *p-n-p* transistor. One can understand the need for the points to be very close together—about the same distance as the thickness of the base in a junction type, and for the same reason. And one would expect the "inter-electrode capacitance" to be much less than in the junction type with its relatively large area of contact. This is indeed so, and at least partly accounts for the higher frequencies at which point transistors can work. The fact that electric field intensity close to a sharp point is much larger than around flat or gently curved electrodes (which is why sharp points are avoided in high-tension apparatus, except for discharge purposes) accounts for the lower back voltage at which a point-contact rectifier breaks down. The small contact area would also suggest a relatively low-power-handling capacity.

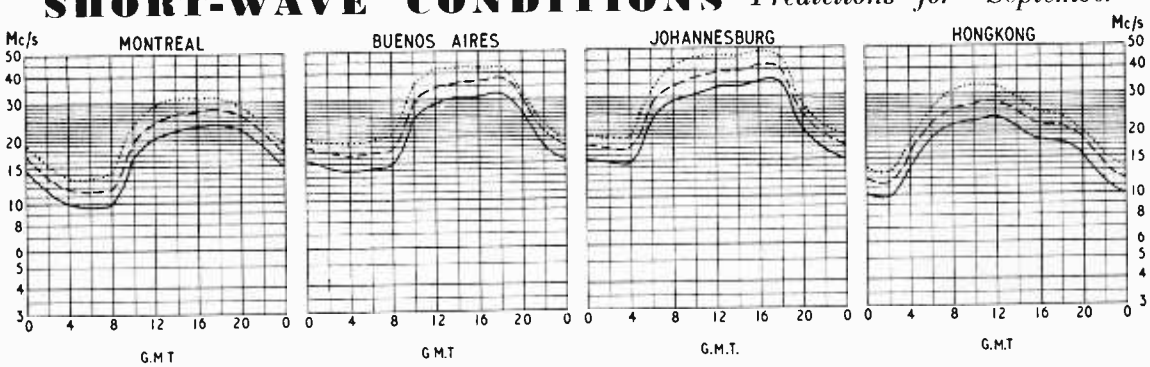
But none of these things might instantly lead one to predict that point transistors are far more noisy than junction transistors (which in their turn are somewhat more noisy than valves). Or—even more important—that their α should, unlike that of the junction types, be greater than 1. Yet such is the fact. And not merely just greater than 1; a typical figure is 2.5. Fig. 9 shows some earthed-base characteristic curves, which should be compared with Fig. 7. First, one notices their curvature and their less perfectly even spacing. And then the higher scale of collector voltage. And perhaps last of all the fact that each milliamp change in emitter current increases the collector current by two or three milliamps.

Much has been written by the scientists to explain this. But so far the only conclusion the observer on the side lines is able to draw with any large amount of confidence is that the *p-n-p* description just given is an over-simplification. Some authorities, for instance, show several layers around the point. And much is said about "trapping" and other effects I have spared you. Pending the results of further research we may just have to accept the >1 value of α as a fact.

It is an exceptionally important fact to remember, because it means that unless one uses a point transistor very carefully it may go into saturation or oscillation and destroy itself by excessive current quic' er than one can think. It would be very unwise, for example, to make the connections to collector and emitter prior to that for the base (as in Fig. 2). Any current flowing through the e-b contact would (as Fig. 9 shows) cause a greater current to flow through the b-c contact, but that increased current would flow also through the e-b contact, which would increase the current still more . . . and so on until something went bust. Even a circuit based on the innocent-looking Fig. 10 is not safe. Here, following valve practice, R is being used as a substitute for the emitter bias battery in Fig. 6(b). Fig. 9 shows that the directions of the currents will be as indicated by the arrows in Fig. 10, and I_b through R will bias the emitter positive, which is correct for a transistor with *p-n-p* polarity. But, whereas a cathode resistor in a valve causes negative feedback which tends to stabilize things, a base resistor in a point transistor causes positive feedback and possibly instability, as can be seen by considering Fig. 10 with the aid of Fig. 9 to show what happens when current is increased, say from zero on switching on. Remember that quite a small increase in emitter voltage causes a substantial increase in emitter current, for it is a forward-biased rectifier.

At the present time point-contact transistors are needed in spite of their disadvantages, because their high α is convenient for trigger circuits in computers, etc., and because available junction types are more or less ineffective at the higher radio frequencies. The high-frequency shortcomings having been already largely overcome in the laboratory, it is presumably only a matter of time for junction transistors to displace the point type almost if not entirely.

SHORT-WAVE CONDITIONS *Predictions for September*



THE full-line curves given here indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during September.

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.

..... FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE FOR 25% OF THE TOTAL TIME

— — — PREDICTED AVERAGE MAXIMUM USABLE FREQUENCY

——— FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE ON ALL UNDISTURBED DAYS

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More Lines or Colour?

Though it is generally believed that the next major step in television will be to add colour, the alternative of higher definition has had some support. In this article a studio producer gives his views

By IAN ATKINS*

COLOUR will not wait. When it is ready we shall get it, but that will not be until it is possible to make a good, stable receiver at a moderate cost. In my view, given the receiver, colour will be with us whether we like it or not. The alternatives we may expect surely are colour on 405 lines or colour with a higher standard of definition. "More lines or colour?" is an academic question. I shall give it a most unacademic answer.

From the purely selfish and personal point of view of the studio producer the key to the answer lies in another question. What do we want to present on the television screen? Television can now do some things well and others less well. Do we want to do even better the things we now do well? Or do we want as it were to balance things up and improve in the respects in which we are now lacking?

This "intimate, domestic medium," excels at present in the realistic. Actualities, outside broadcasts, travel programmes and other similar features are well served by the present standards of definition. The great popularity of the dramatized documentary programme is further proof of the success of realism on the television screen.

Writing in *Wireless World* for May, 1956, Dr. D. A. Bell said:

"The great advantage of the higher definition is that large-scale effects can be presented with adequate detail—e.g., a display of massed folk dancing—and solo artists are normally presented as three-quarter-length or full-length portraits, not head and shoulders only. It liberates television from the state of being a specialized art having limited effects at its disposal in order to *represent* some form of entertainment and makes it as free as the black and white film to *reproduce* visual entertainments where so desired, or use more natural "shots" if the moving picture is regarded as an artistic work." (Dr. Bell's italics.)

Dr. Bell is saying that higher definition will, above all, improve television's ability to report; he adds, by way of afterthought, that "if the moving picture is regarded as an artistic work" there will be some advantage in this direction also. This "liberation" is pretty cold comfort to the studio producer who sees television's task as in part to report, to reproduce and, equally important, in part to move towards establishing itself as an art form—in fact, to represent. The cinema is most memorable when, for all the freedom of its higher definition, it most uncompromisingly demonstrates that it is a specialized art. The picture is not, I am sure, as depressing as Dr. Bell paints it. Higher definition would provide advantages to the creative worker in television—not because he could eliminate the close-up, eschew all the potentialities of the camera to select and emphasize, show all his characters in threequarter or full-length figure and turn the viewer's screen into a miniature proscenium arch, but because the effects at the disposal of his specialized art would be less limited. He could work in general with his cameras a little farther away from the scene. In particular, he would not be in the present predicament of fearing that, if a character's hands are on the screen, his head may be too small for subtle facial expression to be seen clearly in the average home. He could also view the steady increase in the size of viewers' screens with equanimity.

But, and a very big "but," given reasonable definition picture "quality" is what really matters. I must not try to become technical, but is not this "quality" a matter of tonal gradation, a function of noise, contrast range, gamma and so on? These are factors not inherent in the standards of definition of a system. A picture with the whites crushed and spurious modelling apparent on the faces must be just as horrible on 819 lines as on 405.

Higher definition will enable me to show a room on the screen more clearly, but will it help me to create more successfully that room's "atmosphere"? I think not. To capture that atmosphere must we view in a new "dimension"? Is colour that dimension?

Monochrome Limitations

Television programmes cover a vastly wider range of type and style than the commercial cinema in its monochrome period. If the successes of the film documentary and *avant-garde* groups are added this disparity is perhaps not so great, but what is significant is that the areas in which television is, and black-and-white films were, less successful show a marked degree of identity. No really satisfactory way of presenting the dance on the black-and-white screen has been evolved; realism succeeds, the unrealistic, the stylized is a much more chancy business; the black and white screen can be made to glitter, but it does not often glow.

It is in this realm of the un-realistic that I believe colour will open up vast new possibilities. Fussy detail and overcrowded background will give place to simplicity, but a warm and satisfying simplicity; neither cold grey emptiness nor hard black void.

Of course, we shall make mistakes with colour. We shall at first think of it for its own sake and not as a means to an end. People will say, as they say about any new technical advance in any medium that colour has "put television back twenty years." But we shall hope to make these mistakes during an experimental period. Where we shall be lucky is in the fact that, for obvious reasons, the introduction of full-scale colour programmes will be a gradual process. We shall be able to present in colour those programmes which manifestly gain from it and to

* British Broadcasting Corporation.

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take time to learn why in others the gain appears to be a minus quantity.

This literally rosy prospect will, however, be conditioned by one factor; whether colour is introduced on present standards or at higher definition. Whether "compatibility" in the strictly technical sense is a requirement of the system or not, a monochrome picture will undoubtedly be derived from the colour programme and that monochrome picture will have to be good. A considerable proportion of the experimental period will have to be spent in establishing the studio conditions necessary to give both good colour and good black-and-white.

The purely personal, selfish and parochial view of one studio producer, then, is "colour first and higher definition afterwards."

Does a less selfish and more forward-looking consideration alter this view? Is colour on 405 lines really good enough? Does it yield pictures as good as the present black-and-white picture? Are we right in hoping that the introduction of colour will not reduce the apparent definition? (May not, in fact, the addition of colour enable the viewer to pick out details by differences in hue, whereas on a monochrome picture he can distinguish only between different shades of grey?) Is the compatible picture on a monochrome receiver up to the requisite standard? Is the "reverse compatible" black and white picture on a colour receiver up to the requisite standard? There is at present, I believe, sufficient diversity of view among the experts on the answers to these questions to frighten into silence the most foolhardy of the in-expert who cannot know whether a present defect is due to the system or standards in use on the one hand or to a particular piece of apparatus, a link in the electronic chain to-day, but due to be superseded to-morrow. We must trust the experts to make the right decisions. They have not let us down in the past.

More lines instead of colour, then? Surely to discuss the introduction of a higher standard of definition in the present Bands I and III is wishful thinking. Higher definition must mean, in this country, going to Bands IV and V. To do this without also introducing colour might be easier, but would it not also be lamentably un-courageous?

Wired-in Valves

REASONS FOR USING THEM

By E. G. ROWE, M.Sc., D.I.C., B.Sc.(Hons.), A.C.G.I., M.I.E.E.*

IN the past the valve as a component has taken the blame for 50% of all equipment failures—if it is fair to blame something for failing to stand up to conditions for which it was not designed. The Special Quality valve, however, has been designed to work under arduous conditions, and with such valves the basic reliability of this component has improved vastly. With this position established, and an assurance that if valves are used correctly and conservatively there will be a very low failure rate up to the normal length of life, then there is a good case for wiring-in valves in the same manner as other circuit components.

The major difficulty here is that of custom, and it is hard to change the mentality of the servicing technician whose first approach to the diagnosis of an unusable equipment is to pull out the valves. This tendency is overcome by making this instinctive action not possible and results in many advantages. Some 30-50% of the valves so removed are perfectly satisfactory when tested, whilst many modern equipments are so compact that the removal of valves often results in mechanical damage to them. Then again, the use of soldered-in valves highlights the importance of giving the earliest consideration to methods of fault diagnosis and makes it necessary for the equipment designer to supply detailed procedures that will enable the real faulty component to be removed—this will improve the "unreliability record" of the valve to a surprising extent!

At the same time, it will give emphasis to the value of marginal checking techniques. Valves must die eventually of general deterioration of characteristics, but by routine diagnosis of the equipment performance it is possible to forecast potential failures and thereby increase equipment reliability by a whole order or more.

Next, by making valves with flexible leads instead of pins the valve manufacturer is able to produce a stronger glass article, and because there is no

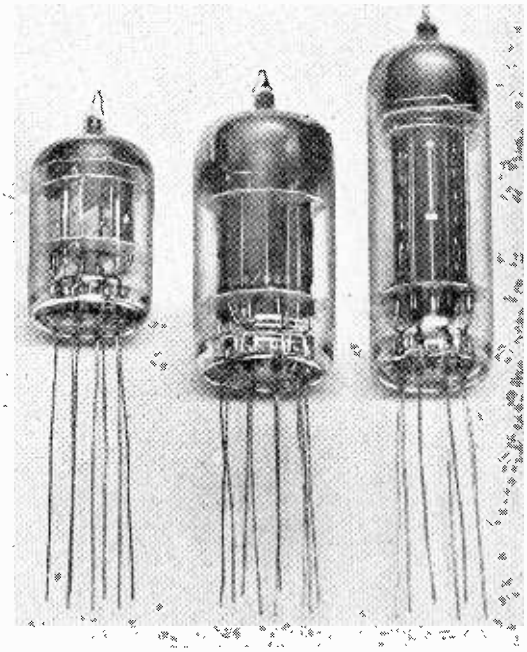

Fig. 1. Examples of flying-lead valves suitable for direct wiring-in and clamping by the user.

* Standard Telephones and Cables.

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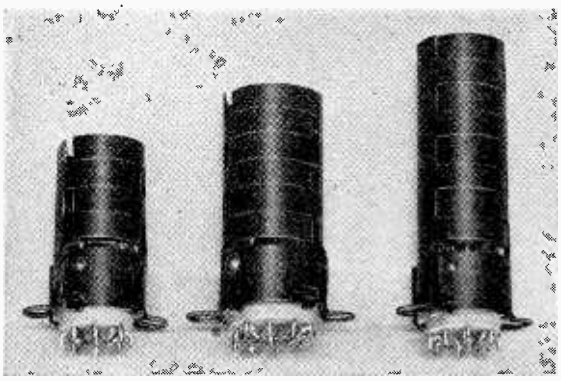

Fig. 2. Flying-lead valves already mounted in cooling cans and connected to soldering tags corresponding to conventional valveholders.

mechanical incompatibility between the valve pin spacings and the valveholder contacts there is no risk of strains being set up that will result in broken and leaky valves in service.

Finally, by dispensing with the conventional valveholder it is easier to provide satisfactory intimate metallic contact to the glass envelope and thus achieve greater cooling. The question of bulb temperature is now being studied extensively, and it is established that the life of a valve is very dependent on this temperature. Reducing it by 50-60°C can increase the life in many cases by four or five times. By using black metallic clamps specially designed to touch the bulb at as many places as possible the hot spots are evened out over the bulb surface, and then by secure fastening of the clamps to the chassis the heat is conducted away efficiently.

Many users purchase flying-lead valves in the form shown in Fig. 1 and design their own clamps to fasten the valves horizontally on the chassis. The ordinary U-shaped saddle, with the metal band situated at the hot spot of the glass envelope, is one of the simplest methods. Other users prefer to maintain their present circuit techniques and mount the valve in the usual vertical position. To suit such requirements a range of Special Quality valves is available in which the user is supplied with a "valve component" as shown in Fig. 2. This is a flexible-lead valve with its own cooling shield and with soldering tags in the conventional pin positions. The can has two lugs with normal hole fixings and thus the "valve component" replaces the usual arrangement of valveholder, valve and shielding can or springs.

The time has now arrived when the adoption of such wired-in valves, used conservatively and correctly with approved maintenance and marginal checking procedures, will produce equipment reliabilities very much in excess of those at present being achieved.

COMMERCIAL LITERATURE

High Quality Amplifier, 5-watt (No. 1 "Symphony," Mark III) with flexible tone control for treble, middle and bass. Negative feedback and scratch-cut are incorporated and also tape "record" and "play-back" sockets. Other amplifiers, tuners (a.m., f.m. and a.m./f.m.), radiogram chassis and loudspeaker cabinets and baffles. Illustrated catalogue (C.24) with price list from Northern Radio Services, 11 and 16, King's College Road, Swiss Cottage, London, N.W.3.

Atomic Power Stations; a booklet with sketch illustrations briefly outlining future plans and explaining the activities of the Atomic Energy Group formed by G.E.C. and Simon-Carves. From The General Electric Company, Fraser and Chalmers Engineering Works, Erith, Kent.

Electronic Measuring Instruments by well-known makers. A current price list of the equipments supplied and maintained by F. C. Robinson and Partners, 122, Seymour Grove, Old Trafford, Manchester, 16.

Precious Metals for electronic and electrical engineering and other purposes. A well-produced booklet, "An Industry Within Industry," consisting of large photographs and extended captions describing the activities of Johnson Matthey and Co. From their head offices, Hatton Garden, London, E.C.1.

American-Type Valves (Western Electric type numbers) manufactured by AB Svenska Elektronror, a subsidiary of Ericsson, of Stockholm, Sweden. Catalogue with full data and characteristics from the representatives for U.S.A., Canada and export, State Labs Inc., 649, Broadway, New York 12, N.Y., U.S.A.

Cable Eccentricity Gauge, electronic, working on comparison of capacitances between conductor or sheath of the cable and two external self-aligning electrodes. Sensitivity to 0.5 per cent of wall thickness. Description in a leaflet from the Addison Electric Company, 10-12, Bosworth Road, London, W.10.

Mobile Radio Systems; v.h.f. transmitters and receivers for fixed stations, transmitter-receivers for motor cycles and larger vehicles, h.f. and v.h.f. pack sets. Descriptive leaflets with detailed technical specifications in a folder from the British Communications Corporation, Second Way, Exhibition Grounds, Wembley, Middlesex.

Nickel-Cadmium Hermetically Sealed Cells, rechargeable like conventional accumulators. An article describing the use of the Perma-Seal types of the German Edison Accumulator Company for the l.t. supplies of battery and mains/battery portables; arrangements for trickle charging, economy operation and vibrator h.t. supplies are outlined. Obtainable from A. M. Allen, of G. A. Stanley Palmer, Maxwell House, Arundel Street, London, W.C.2, agents for the cells.

Components and Accessories; an illustrated catalogue for August, 1956, from Radiospares, 4-8, Maple Street, London, W.1.

Stabilized A.C. Power Supply, giving 200 watts at 2.4 kc/s (also models for 400 c/s, 1 kc/s and 1.6 kc/s). Voltage, 115V r.m.s.; regulation, less than 1 per cent change in output voltage from zero to full load; distortion less than 2 per cent. Descriptive leaflet from Shandon Automation and Electronics, 6, Cromwell Place, London, S.W.7.

Television Replacement Parts. Servicing hints on various commercial receivers and details of a transformer rewinding service are included in the latest illustrated catalogue from Direct TV Replacements, 134-136, Lewisham Way, New Cross, London, S.E.14. The price is 1s including postage.

Glass-Sealed Resistors (by Victoreen Instrument Co., U.S.A.), notable for high accuracy and long-term stability under extremes of temperature and humidity. Values 100Ω-10^{14}Ω, tolerances 1-20 per cent, power ratings 0.5-10W, max. temperatures 100-200°C, temperature coefficients mainly negative. Leaflet from the U.K. agents, Anglo-Netherland Technical Exchange, 3, Tower Hill, London, E.C.3. Also a leaflet on Victoreen voltage regulator tubes.

Broadcast Transmitter, 5-kW, for 535-1,620 kc/s (as ordered), in three cubicles. Frequency stability ±5 c/s, audio response 50 c/s-10 kc/s +2 dB at 95 per cent modulation. Power consumption, 13 kW for average programme, claimed to be unusually low. Specification on a leaflet from Gates Radio Company, 13, East 40th Street, New York 16, N.Y., U.S.A.

Rotary Rheostats; three new models for replacing slider resistors in industrial controls. Values, 3-15,000Ω; current ratings between 173 mA and 12.9 A. Leaflet from The British Electric Resistance Co., Queensway, Enfield, Middlesex.

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Further Education

WITH the opening of the scholastic year we have received details of a considerable number of special courses from which a selection is given below.

Microwave Techniques.—A series of thirty lectures on techniques and measurements at microwave frequencies will be given by Dr. D. R. Workman at Battersea Polytechnic, London, S.W.11, on Wednesday afternoons (3.0 to 5.0) commencing on October 10th. The first twenty lectures (Part I) will cover the general practical techniques used at these frequencies and Part II will deal with some of the applications of microwave techniques. The course is suitable for physicists and electrical engineers with a general knowledge of electrical and electronic principles. The fee for the course (or Part I only) is £2. Dr. Workman is also giving a parallel course on the theory of microwave circuits for graduates in physics, mathematics or electrical engineering, on Wednesdays at 6.30. (Fee £2.)

Colour Television.—The Television Society has arranged for a course of five lectures on colour television to be given during September by P. S. Carnt, of the G.E.C. Research Laboratories, in the Assembly Hall, Institute of Education, Malet Street, London, W.C.2. The lectures, which cover the fundamentals of transmission and reception of the N.T.S.C. system, will be given on four consecutive Mondays, beginning September 3rd, and on Friday, September 28th. Tickets for the course (fee £1) are obtainable from the Television Society, 164 Shaftesbury Avenue, London, W.C.2.

Advanced Courses.—Part-time courses in higher technology, provided at colleges in London and the Home Counties, are listed in a bulletin issued by the Regional Advisory Council for Higher Technological Education. In general, the bulletin includes advanced courses in the various branches of engineering, science and chemistry which do not regularly appear in college calendars or prospectuses as part of a grouped course. Over thirty colleges are listed and abridged details of about 250 courses are given in the bulletin, which costs 1s 6d and is obtainable from the Regional Advisory Council, Tavistock House South, Tavistock Square, London, W.C.1.

Radar Maintenance.—The next two-year evening course at the Norwood Technical College, Knight's Hill, West Norwood, London, S.E.27, in preparation for the Ministry of Transport radar maintenance certificate begins on September 24th. It will be held on Mondays and Tuesdays from 6.15 to 9.15. The college also runs a full-time course beginning on September 12th in preparation for the examination to be held early in December. The 1956/1957 prospectus from the college includes details of thirty-one part-time day and evening courses under the general heading "telecommunications."

Technical Writing.—A course of six lectures on the technique of technical writing is to be given by Geoffrey Parr (hon. sec. of the Television Society) at the Borough Polytechnic, Borough Road, London, S.E.1, on Fridays at 2.30 p.m. commencing on October 12th. (Fee 10s.)

Special evening courses arranged at the South East London Technical College include one of twenty lectures on "Operational Calculus with Applications to Electric Circuit Theory" (Tuesdays, beginning October 23rd) and another on "Vector Analysis and Fundamental Electromagnetic Theory" (Fridays, beginning October 26th). Fee for each is £2.

Sandwich Course.—Details of an engineering sandwich course (alternate weeks in college and industry) in communications, electrical or mechanical engineering, have been received from the South East London Technical College, Lewisham Way, S.E.4. The object of the four-year course is to provide a theoretical and technological training comparable with that of an engineering degree but so arranged that the student's theory will advance concurrently with his industrial training and provide a qualification acceptable for membership of the Institutions of Electrical and Mechanical Engineers.

Northern Polytechnic.—The telecommunications section of the prospectus from the Northern Polytechnic, Holloway, London, N.7, includes details of full- and part-time day and evening courses. At the end of the four-year full-time telecommunications course, students enter for the Grad. Brit.I.R.E. exam. and for the C. and G. full technological certificate in telecommunications engineering. The syllabus for the five-year telecommunications evening course also covers the requirements for these exams. The Polytechnic also provides evening courses in radio and television servicing, radar, electronics, electro-acoustics and computers.

Part-time day and evening classes to be held at the **Bognor Regis** Technical Institute include the City and Guilds radio service work course, and a telecommunications engineering course.

At the Brentford Evening Institute, Clifden Road, **Brentford,** Middlesex, classes will be held in radio and television servicing and for the radio amateurs' examination. There will also be a mathematics course. Fees range from 10s to 15s for the 37-week session.

Amateur Courses.—The East London group of the R.S.G.B. has again arranged, in conjunction with the Essex County Council, for amateur radio courses to be held at the Ilford Literary Institute (High School for Girls), Cranbrook Road, **Ilford.** An eight-month course for those intending to take the radio amateurs' examination will be held on Wednesdays at 7.30 and a six-month morse course on Mondays at 7.30. The classes start in the week beginning September 24th. Further information is obtainable from C. H. L. Edwards, 28 Morgan Crescent, Theydon Bois, Epping, Essex. Similar arrangements have been made by the Grafton Radio Society (Sec., A. W. H. Wennell, 145 Uxendon Hill, Wembley Park, Middlesex) with the London County Council for courses at Grafton School, Eburne Road, **Holloway,** London, N.7. Theory is taken at 7.0 and morse at 9.0 on Mondays, commencing September 24th.

Classes for the radio amateurs' examination will again be held at the Wembley Evening Institute, Copland School, High Road, **Wembley,** Middlesex, on Mondays and Thursdays, beginning September 17th.

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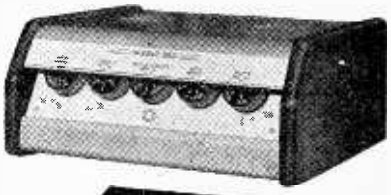

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RANDOM RADIATIONS

By "DIALLIST"

A New Resistance Alloy

DID you, I wonder, see the account of a new resistance wire, known commercially as Evanohm, which was published as an official N.P.L. communication in the July issue of Part B of *Proc. I.E.E.*? Evanohm is an alloy of 73 per cent nickel, 21 per cent chromium, 2 per cent copper, 2 per cent aluminium and 2 per cent other metals. Older alloys, such as manganin and constantan, have many good points; but it is exceedingly difficult to produce either commercially with the stability needed for standard resistors used at ordinary room temperatures. Evanohm, besides having three times the resistivity of manganin, can be given the required low temperature co-efficient by simple heat treatment. The values of resistors made with it have been found to remain stable within a few parts in 100,000 per year. Almost its only disadvantage seems to be that hard soldering is necessary. This new alloy should be most useful in precision electrical apparatus, particularly in circuits whose time constants must be stable.

Terminology

UNLIKE A. Hardwicke (p. 282, June issue), I find the use of such expressions as "fire," "fire at" and "trigger-off" expressive and useful electrical terms. After all, guns aren't necessarily military weapons; they have their peace-time uses both for sporting purposes and for the mere filling of the pot. What the trigger does is to start a sudden violent action, and triggering-off seems to me just the right expression for what happens when, say, a pulse is applied to a flip-flop circuit. What, again, is an electron gun expected to do but fire electrons at a target? And doesn't the intransitive fire describe most graphically the coming into action of a thyratron? No, I'm all for sticking to those terms; but I'm not at all sure that we ought not to come into line with most other peoples of the world by making the word billion signify 10^9 instead of 10^{12}. As it is, when one comes across billion, trillion, and so on, in French, American and other foreign publications one has often to pause for a moment to find out how many noughts the writer intends to follow his first figure.

"You're on the Air . . ."

HAVE you seen the leaflet "You're on the Air, Mrs. Smith," published by the G.P.O. and obtainable at any post office for the asking? It's well and simply written and should bring home to many people the fact that a considerable variety of domestic and workshop appliances can, if they're not fitted with suppressors, ruin both sound and television reception in neighbouring homes. I feel that the G.P.O. would do well to make it more widely known that this leaflet is available free of charge. In the week before this was written I asked a dozen householder friends if they'd seen the leaflet and not one had so much as heard of it. The next test was still more illuminating. During a visit to a neighbouring town I went into the head post office and asked for a copy. The man behind the counter looked puzzled, but, having received my assurance that it must be in stock, he consulted a colleague, who was equally baffled. He then retired into the bowels of the building to make further inquiries, and after a short wait I got my copy.

A British Speciality

OURS was the first country to make use of underwater television. The original underwater camera was built, if you remember, by Marconi's in 1951 in response to a rush order from the Admiralty, who wanted the instrument as an aid to locating the wreck of the submarine *Affray*. Its success was beyond the wildest expectation. Several wrecks had been located on the sea bottom in the area where the disaster took place; but the TV camera identified one of them as that of the submarine without a shadow of doubt. As it was moved about the wreck the nameplate (I hope that's the correct nautical term!) was seen on the receiving screen. Since then wide use has been made of Marconi and Pye submarine cameras not only by salvage vessels but also by marine biologists and oceanographers. Two years ago Pye designed a special model for the search for the Comet 'plane, lost off the island of Elba. Many of these have since come into use in Canada, Australia, New Zealand, the U.S. and other countries. I also hear that a further large batch of "Elbas" is likely to be used in next year's investigation by American scientists of the polar ice-caps.

People Are Funny

WHAT queer ideas people do get about television! A friend told me the other day that he simply must

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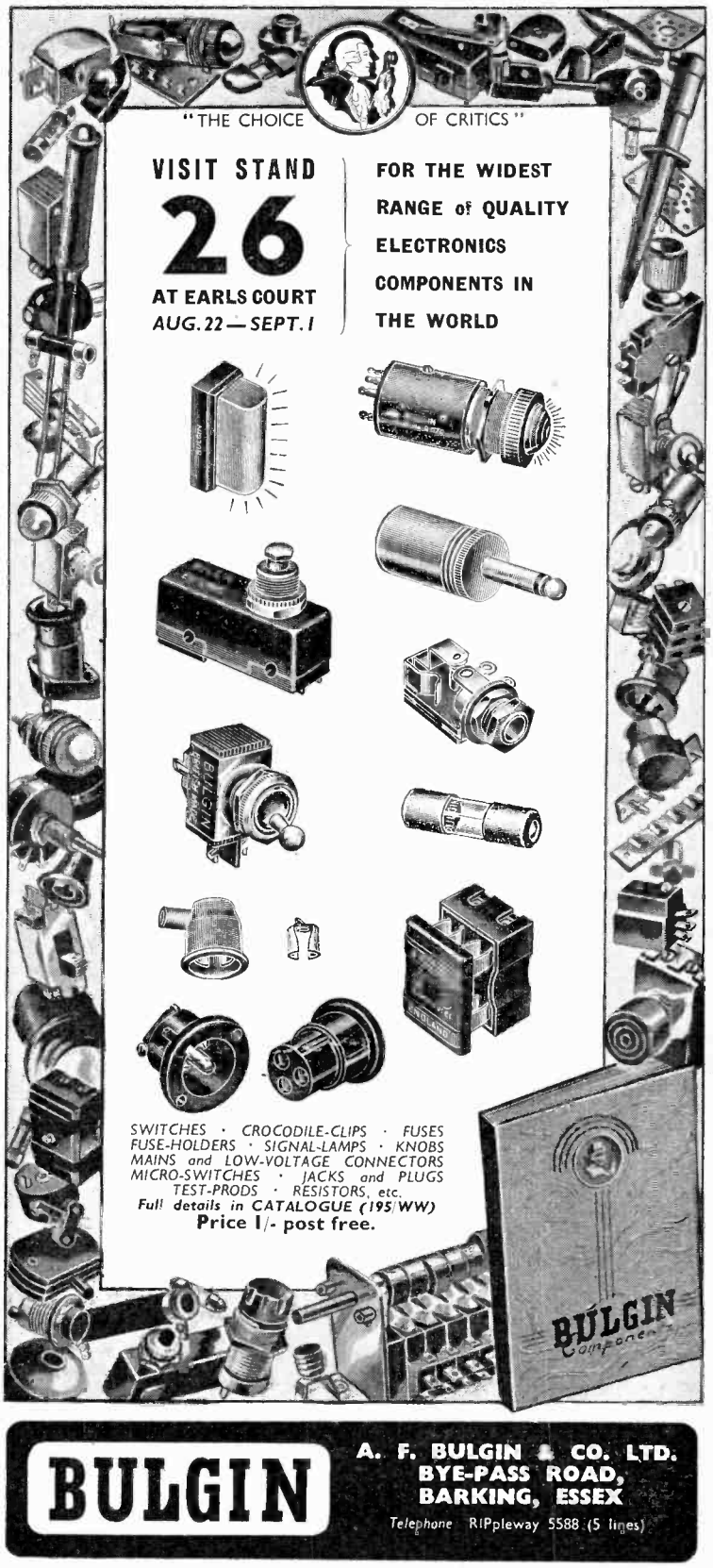
get a receiver with a larger screen. He has a 10-inch screen, from which his eyes never move when cricket is being televised. When I asked why he needed something a size or two larger he said: "Because I want to be able to see the ball. With my set I can't always do so, but I find that I can if Jones invites me to watch a match on his 17-inch receiver." My endeavours to convince him that whatever was on Jones's screen must also be on his were not at first entirely successful. "You may be right," he said, "but all I can say is that if the ball's on my screen, it's so small that I can't see it." Then the solution occurred to me. I asked how far from his set he usually sat. "Oh," he said, "you won't catch me out there. I do always what the experts recommend and sit as far as possible from the screen." How he'd got hold of that idea I don't know; but I found that he normally sat a good ten feet from the screen—and had been doing so for years! I demonstrated by means of the back of the proverbial old envelope that his picture viewed at five feet would appear to be of exactly the same size as Jones's at about 8½ feet. Having now moved his chair to the right distance, he is able to enjoy his cricket without having to go round to his friend's house.

Triangular Cabinets

FREE GRID'S suggestion that some enterprising manufacturer should turn out television sets with triangular cabinets because they fit so comfortably into the corners of rooms comes a little late in the day. The suggestion was made some years ago in "Random Radiations" for console sound receivers and radiograms and was adopted by the Ambassador people, who found it very popular. Whether any television sets are made with such cabinets nowadays I can't say offhand, though my impression is that there are one or two. Cabinets of this shape, whether used to house sound or television receivers, could benefit not only the listener or viewer but also the serviceman. If the cabinet is rectangular, only the back can be detached and many parts of the "works" are inaccessible unless the chassis is taken out. With a triangular cabinet, on the other hand, both of the sides behind the front panel could be made removable; or the back might consist of a single V-shaped piece. In this way the serviceman could get at much more of the inside of the set without having to take out the chassis.



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UNBIASED

By FREE GRID

Electronics on the Roads

I HAVE been studying an article in the American periodical *Tele-Tech and Electronic Industries* which deals with the question of reducing car accidents by electronic means. One suggestion which has real merit is the development of electronic "trainers." Presumably these would be on the lines of the system used in flying training and this has proved itself over and over again.

Other suggestions in the article are of less importance but nevertheless capable of considerable development. Many of them appeared in these columns a generation ago but I have never found time to put them into practical form. Thus *Tele-Tech* suggests the use of a capacitative pick-up on a car so that if it approached too close to an obstacle ahead, be it another car, a jaywalker or a brick wall, the brakes would be automatically applied. I put forward a somewhat similar suggestion using photocells 23 years ago. The snag was that by the time the car got within range it would have been too late for the brakes to be applied. In my opinion this snag of too limited a range would apply with equal force to any capacitative arrangement.

The boldest and most unusual suggestion put forward by the writer is that "leader" cables should be buried in the ground on certain highways. These cables would carry control frequencies which could take complete charge of the car. The driver could then drop off to sleep like the coachman of the old horse-drawn trams who used to leave everything to the guiding effect of the rails and the intelligence of his horses.

Datatron

MOST of you will have read about the latest type of electronic machine, hailing from America, which composes the music for over a thousand songs an hour. It has been called the Datatron and when I first heard this name I thought it a very poor effort as it did not distinguish this mechanical Mozart from any other type of electronic computing machine for all of them have to be fed with data before they will do their stuff.

But as I realized later, I had wrongly jumped to the conclusion that the coiner of the word datatron had taken an old and familiar friend, the latin word "data" and had married it to the Greek suffix "tron." In this I was no better than the Ministry of Information official who noticed an article on the homodyne in this journal during the war (April, 1942) and passed a marked copy to the Ministry of Labour and National Service in case it might help them to solve the very pressing manpower problem.

I apologize to the man responsible for this ingenious name for it is not a miserable Latin-Greek hybrid. Not only is it all-Greek and, therefore, etymologically unobjectionable but it is a very descriptive word. The "data" part of it is obviously derived from the Greek verb δατεομαι (dateomai) which means, among other things, "to tear to shreds."

Anybody who studied the doggerel and pedestrian piece of music published in the newspapers recently as one of the Datatron's efforts will at once realize that it is indeed music reduced to rags and tatters. These banal bars are well-deserving of the title of mangled music. In the past the B.B.C. has been accused of devoting too much of its programme time to canned concerts but at least the music was worth canning. None of our budding Beethovens need fear the competition of this robot Rachmaninoff. No doubt an ACE will soon be constructed to turn out synthetic Shakespeare by the yard.

Sinister Servicing

I FEEL very uneasy to learn that methods smacking of Himmler and the Gestapo have been introduced into the service department of a radio dealer. I am told the dealer has installed concealed microphones and other apparatus on his premises so that, when a customer brings in a set for repair, everything he says is recorded on tape so that it can be used in evidence against him if at some future date a dispute arises as to what the customer ordered to be done to the set. Even the poor wretch's telephone conversations are recorded.

Now at first sight this seems a harmless enough practice and one which serves as a safeguard to the customer as much as to the dealer; I have little doubt that in this particular case all is fair and above board. One can foresee, however, very unpleasant developments if the police start using concealed apparatus to take down the exact words used by some offending motorist whom they stop. Speaking as a motorist myself, I frequently say things in the heat of the moment which, acting on advice, I omit from my evidence when I go into the witness box, and there must be many motorists like me.

"Everything you say . . ."

The unsavoury nature of this Star Chamber method of secret recording initiated by this radio dealer is bad enough but there is a far greater danger in that it is possible for the tapes to be faked by some unscrupulous future user of the system. Is it not possible to produce synthetic records of the human voice on magnetic tape as Rudolf Pfenniger did when he painted sound tracks on films? But there is nothing to stop an unscrupulous gestapo-minded radio dealer, or other person concerned, from painting what he likes on a film track and then running it through a reproducer and re-recording it on magnetic tape.

All he needs is a preliminary secret recording of the customer's voice to tell him whether his accent is Oxon or 'oxton.

A.C.-Phobia in Scotland

MAY I thank the many readers who wrote to tell me why, in their opinion, the filaments of valves and lamps used for a long time on d.c. soon fail when put on to a.c. mains. Naturally the tendency of a.c.-carrying filaments to waggle in synchrony with the alternating magnetic field surrounding them is a contributory cause which everybody recognizes. In fact, an Aberdonian reader is convinced that the earth's magnetic field is a primary cause of early filament failure, and he tells me that he hopes to save many bawbees when he has found the correct angle to tilt his lamps so that reaction between the fields of earth and filaments is at a minimum.

He also points out that in Scottish latitudes the lines of force of the earth's magnetic field are packed closer together than south of the border. In other words, the magnetic field is denser and so filaments fail earlier. The result is that a.c. is none too popular among the thrifty Scots, and I hope the Electricity Board will take cognizance of it.

But magnetic reaction alone is no explanation why d.c.-nurtured filaments soon fail on an a.c. diet. The other ingredient which spells early failure is summed up in the word crystallization. The crystalline structure due to a d.c. diet differs from that due to a.c., and the effect of the change of diet is as disastrous as if a baby were suddenly switched from mother's milk to tripe and onions.

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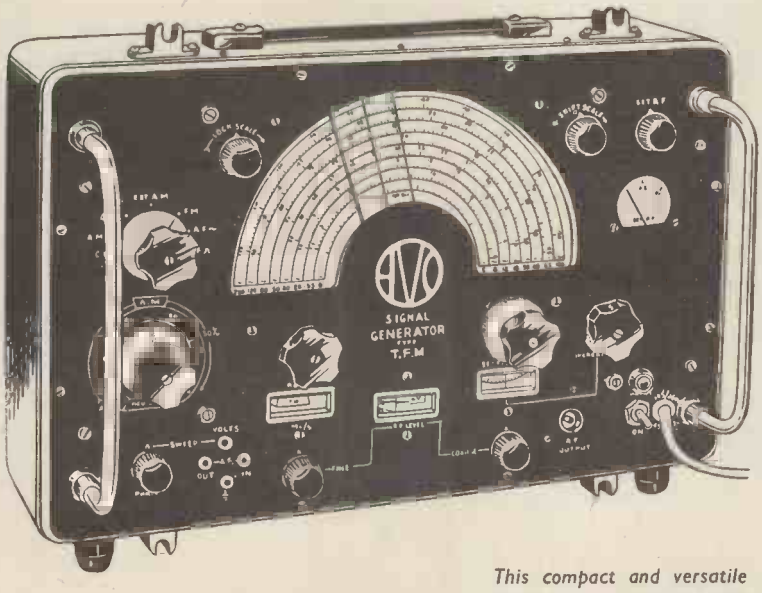
Type T.F.M.

RADIO SHOW Stand No. 3

The design of this new Wide Band Signal Generator, **operating throughout on fundamentals,** is the outcome of considerable research and development work to meet the stringent requirements imposed by new frequency modulation and commercial television stations.



This compact and versatile instrument not only meets all U.K. requirements, but will also prove useful in many other parts of the world.

The frequency bands have been chosen in such a manner as to ensure maximum convenience when servicing and aligning T.V. and F.M. receivers.

Provision has been made for spot R.F. frequency calibration.

Facilities are provided to ensure adequate discrimination throughout the very wide frequency band covered by the instrument.

Sine and square wave audio frequency modulation provided.

The instrument is fitted with an R.F. carrier level meter.

A double-ratio slow-motion mechanism, together with interpolation dial, enables the instrument to be set with a high degree of accuracy. On the F.M. range an internal phasing control enables the modulating signal to be applied to the X-plates of an oscillograph to produce a picture of a discriminator response curve.

AM COVERAGE

5-220 Mc/s in 8 ranges, CW or 400 c/s sine/square wave modulation. Accuracy ±1%. Provision for spot frequency calibration.

FM COVERAGE

65-120 Mc/s. Accuracy ±1%. Maximum deviation ±150 Kc/s.

OUTPUT:
Minimum (about 2μV) to 100 mV continuously variable with decade multiplier. Force output 250 mV.

OUTPUT IMPEDANCE:
80Ω, 200Ω, balanced 80Ω and 300Ω.

OPERATING VOLTAGES:
100-120, 200-260 V, 50-60 c/s A.C. mains.

DIMENSIONS:
15¼ x 10¼ x 10ins. approx. with lid closed.

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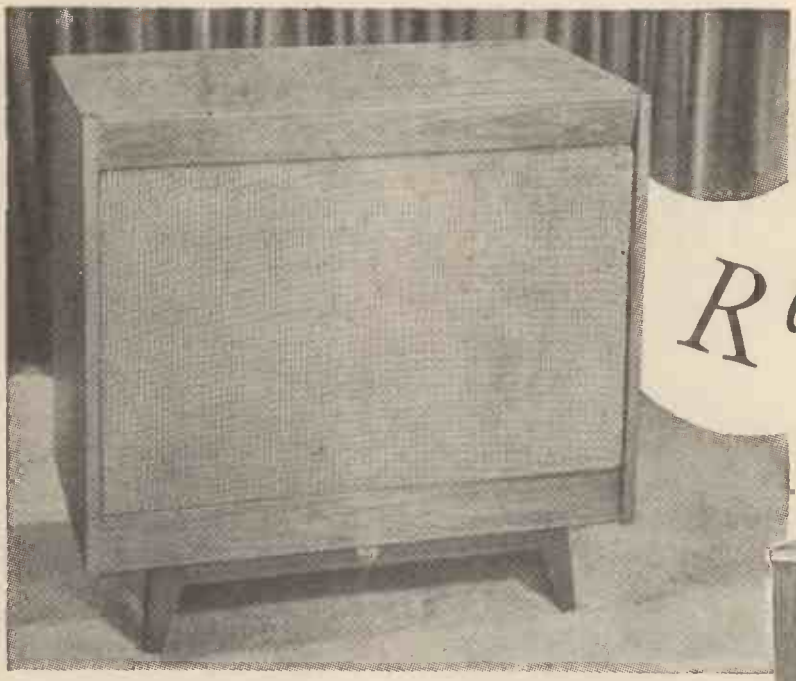
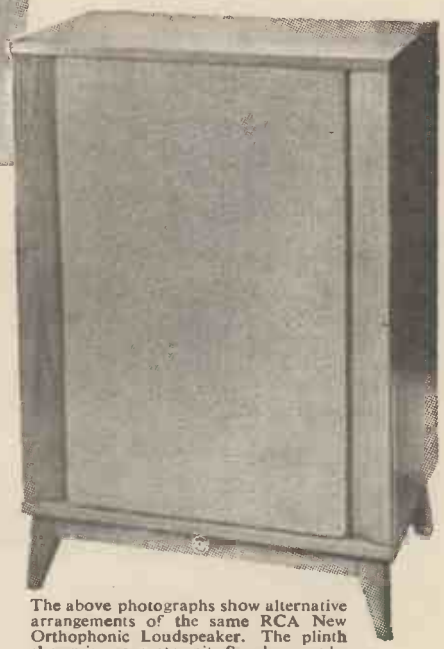


Realism



. . . is not enough!

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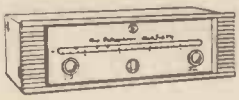
This RCA New Orthophonic High Fidelity speaker system uses advanced acoustical design to give a liveable size with clean aesthetic lines which will harmonise with any furnishing scheme. The system uses a ported bass reflex type enclosure including the exclusive RCA acoustic curtain damping feature. The special arrangement of the triple speaker assembly ensures even sound distribution to all parts of your room with perfectly balanced bass and treble response. This instrument with its great sensitivity captures those elusive elements of sound which make for completely natural reproduction. The RCA Loudspeaker is the latest addition to a complete range of perfectly matched High Fidelity units designed for studio quality, radio and gramophone reproduction in the home. Send for further details.

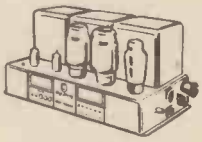
The above photographs show alternative arrangements of the same RCA New Orthophonic Loudspeaker. The plinth shown is a separate unit. Speakers can be supplied in light oak or continental dark walnut finish and without plinth if required.



F/M TUNER

TRANSCRIPTION DECK

PRE-AMPLIFIER



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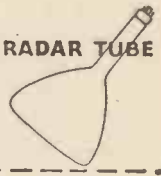
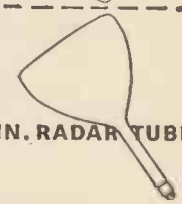
Space saved Focus at ordinary h.t. potential means that e.h.t. generators can be smaller, and bulky high voltage potential dividers eliminated.

9 IN. RADAR TUBE

AL22-10



AL 31-10



12 IN. RADAR TUBE

ABRIDGED DATA FOR BOTH TUBES				
	Typical Operating Conditions			
Focus: Electrostatic Deflection: Magnetic Heater: 6.3V, 300mA Phosphor: long persistence	V_{a2+a4} (kV)	V_{a1} (V)	$-V_g$ for cut-off (V)	V_{a3} focus (V)
	12	300	30 to 70	±200

Write to the address below for full details of these and other cathode ray tubes in the Mullard range.

Mullard

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MVT 187

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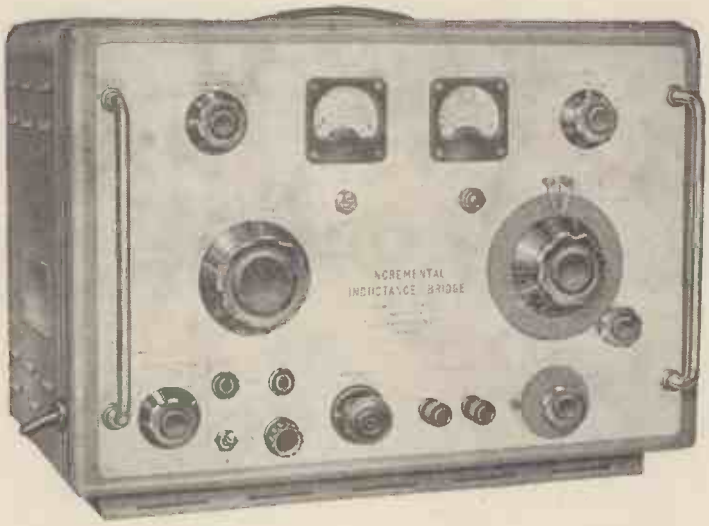

Designed to measure the value of Iron cored chokes and similar Inductors in the range 0·01H to 1000H of Q value not less than 2.

Provision is made for passing any current up to 1 Amp d.c. through the winding and selectable a.c. excitation voltages of 1, 2, 5, 10 and 20V r.m.s. are provided.

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We know that there are many Tape Recorders on the market costing less — some, indeed, much less. But Ferrograph standards of performance and dependability have only been achieved by making cost considerations a secondary matter. The really important question we continually ask ourselves is "Does the Ferrograph still set the standard by which Tape Recorders are judged?" We believe that it does. We believe, too, that a lot of people are proud of their Ferrographs.

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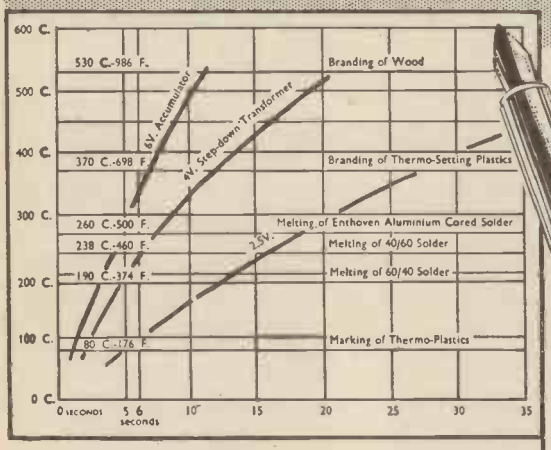

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The effect of different voltages on initial heating-up time is shown. Whilst 4V is the standard voltage normally employed, 6V will cause no harm, and accumulators are a useful source of current supply.

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- Activated by light thumb pressure on the switch ring. When pressure is released, current is automatically switched off — thus greatly reducing electricity consumption, wear on copper bit and carbon element.
- Length, 10"; weight, 3½ ozs.; can be used on 2.5 to 6.3 volt supply (4 volt transformer normally supplied) or from a car battery.
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as being used by the Royal Society Antartic Expedition for the International Geophysical Year.

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The introduction of electronic techniques to the measurement and correction of telegraph distortion brings laboratory precision to the maintenance of modern line and radio telegraph circuits and all equipment, including teleprinters. The equipment described and illustrated on this page is representative of the contribution made by ATE to this field.

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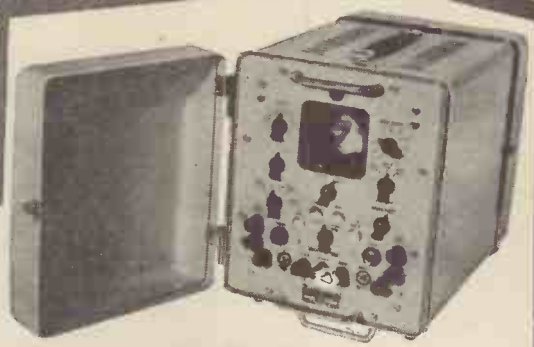
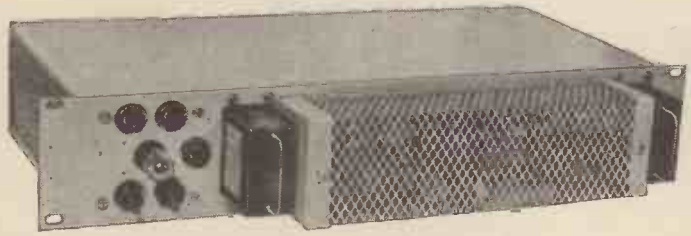
Sends an automatic test message, or characters, or reversals at any speed between 20-80 bauds with or without distortion. The CRO has a circular time base for distortion measurements on synchronous signals only, or relay adjustment. Weight 37 lb.



T.D.M.S. 6A

For distortion measurements on working circuits without interrupting service. Each element of a start-stop signal appears separately on the spiral time base display. Adjustable speeds from 20-80 bauds. Weight 33 lb. Higher speed versions can be supplied to order.



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is a start-stop, five unit code equipment, designed to correct distortion on long line or radio telegraph circuits. It covers the speed range 45, 50 or 75 bauds, and accepts signals with up to 49% distortion.

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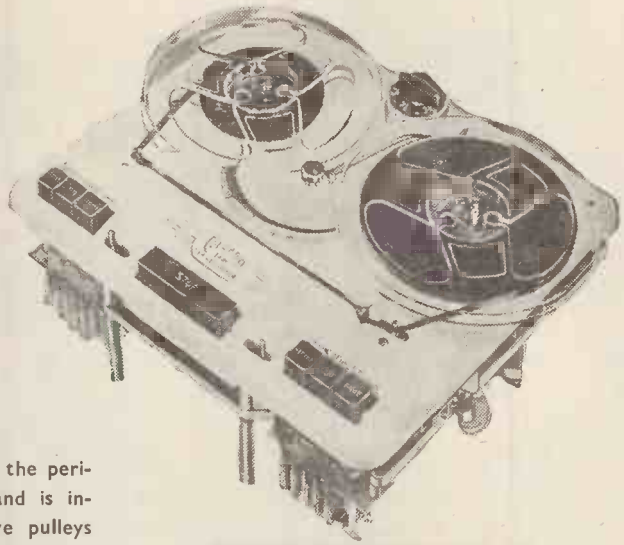
THE *NEW* COLLARO TAPE TRANSCRIPTOR

This new High-Fidelity Tape Deck has been designed on Transcription quality principles for live recording, recording from F.M. Broadcasts, etc., and reproducing pre-recorded tapes. A twin-track model fitted with four heads, it runs at speeds of $3\frac{3}{4}$, $7\frac{1}{2}$ and 15 inches per second. It has low wattage input motors, and the tape tensioning is automatic.

The operation and the braking are mechanical and performed without the aid of rubber belts or solenoids. The 3-speed mechanism effects the final drive through the periphery of a heavyweight flywheel and is instantaneously reversible. The drive pulleys retract automatically when the machine is switched off.



THE 456 HIGH-FIDELITY RECORD CHANGER — 4 SPEED

The latest and most reliable of a famous range of Automatic Record Changers, the 456 is a 4-speed instrument for 16 2/3, 33 1/3, 45 and 78 r.p.m. operation. It will play 7in., 10in. and 12in. records intermixed in any order—provided that all are of the same speed range—and is suitable for A.C. voltages of 100/125 and 200/250.

4-SPEED GRAMOPHONE TRANSCRIPTION UNIT

(MODEL 4T200) for truly faithful reproduction. Entirely new type 4-speed mechanism ensures absolutely uniform speed, with reproduction free from frequency modulation. A very heavy turntable is fitted with a ground and lapped spindle running on to a ball which takes the total thrust of the turntable, and results in correct speed with no detectable "wow" or "rumble."

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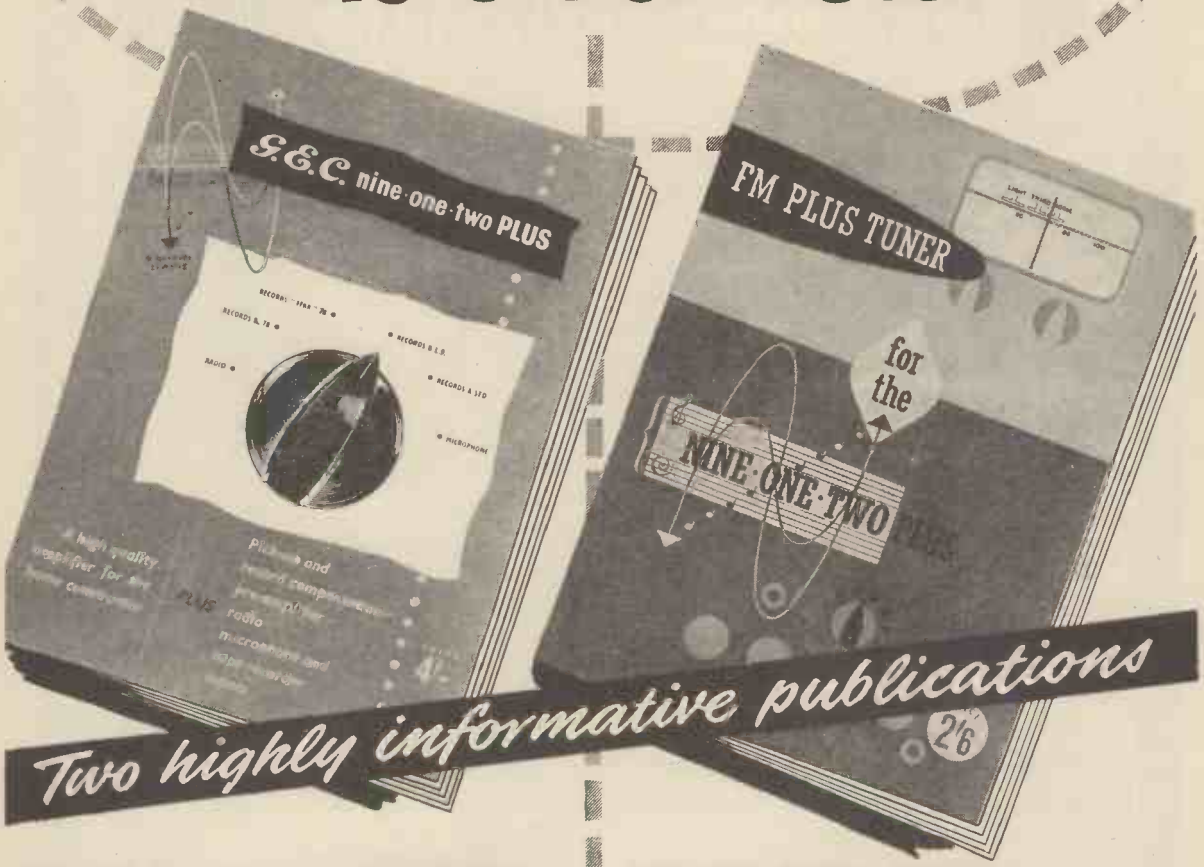
Makers of Record Changers, Gramophone Units, Pickups, Electric Motors, etc.

2 'musts' for the home constructor



THE G.E.C. "nine-one-two PLUS"

This publication contains step-by-step wiring instructions for this high quality Amplifier together with many additional features of exceptional interest to the Home Constructor.

PRICE **4/-** from your dealer or by post—5d. extra—from the G.E.C. Valve and Electronics Dept.

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320 MODELS FOR 1955-56
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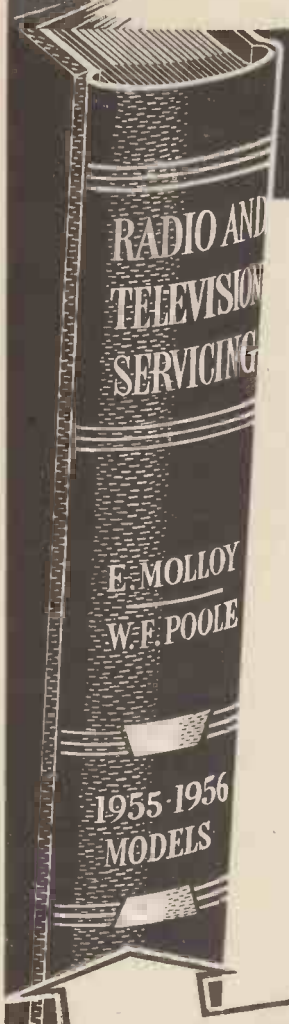

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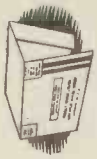

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Midax
A horn loaded pressure driven unit. Frequency coverage 400 c.p.s. to 8 kc/s.

See these new products at the Show

Stand No. 105
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The new TREBAX and MIDAX pressure driven reproducers are focal points of interest at the Radio Show. Designed to give smooth frequency response with extremely low distortion over the middle and top registers of the audio spectrum, these new pressure driven units are additional to the famous AXIOM and AUDIOM ranges of loudspeakers.

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A new high efficiency pressure driven reproducer. Frequency coverage 2,500 c.p.s. to 16 kc/s.

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New 3-speaker system by Wharfedale

AT £37-10-0 COMPLETE

Model SFB/3

With the following attributes:

- ★ **Attractive appearance**
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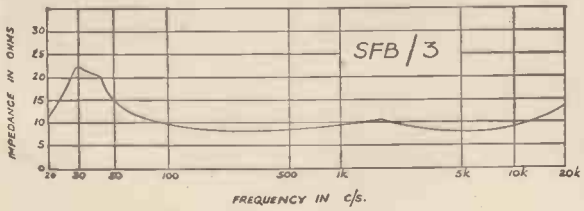
- ★ **Resonance-free: Sandfilled Baffle**
- ★ **Omni-directional**
- ★ **Frequency range: 30 c/s to 20,000 c/s.**
- ★ **Moderate price**

IMPEDANCE CURVE

Note the unusually level impedance which typifies the wide frequency response.



HERE, at last, is a wide range, high quality speaker which can easily be accommodated in the average room, can be placed in the best position for listening, and be moved against a wall when not in use, with choice of Walnut, Oak, Mahogany and Maple Veneers.

SPECIFICATION

Size 34" x 31" x 12"
Weight 60 lbs. Impedance 8/15 ohms.
Bass Resonance 30/35 c/s. Max. input 10 watts.

UNITS:

W12/CS, 10in. Bronze/CSB, Super 3.
The 12in. and 10in. units are in parallel.
This arrangement gives very smooth results over the full range with a 3 dB gain at low frequencies.
The Super 3 is again in parallel via 4 Mfd. capacitor and is mounted on a small baffle facing upwards.

The efficiency of the system is high and will give full domestic volume from any good 5-watt amplifier. The baffle is sandfilled; there is no cabinet resonance because there is no cabinet.

The 12in. and 10in. units are specially built and MATCHED FOR OPTIMUM RESULTS from this system. Baffles cannot be supplied separately.

Tropical model made with bonded plywood can be supplied at £2 . 0 . 0 extra.

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X-BAND OSCILLATOR TYPE S.381

A variable frequency oscillator for the range 3.0 to 3.55 cms. using a CV.2346 Klystron in a co-axial cavity. The output remains constant within ± 2 db over the whole frequency range and the power will be between 15 and 35 mW according to the valve employed. Frequency stability 2 in 10^4 and calibration 3 in 10^4.

Price £150 net ex works (valve extra).

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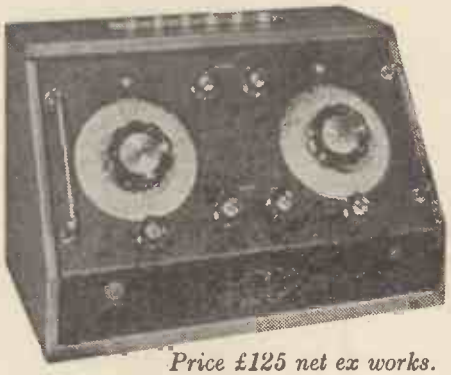
A highly accurate transformer ratio arm bridge for the measurement of capacitance, resistance and inductance within the range 0.01 pF to 0.02 μF, 10 Ω to 10 M Ω and 0.5 μH to 50 mH. It can be used to measure complex impedances, balanced or unbalanced, or between any pair of terminals in delta formation.



Price £125 net ex works.

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Five decades of Minalpha wire resistors arranged in potentiometer form to give ratios between 0 and 1 in steps of .00001. For ratios between 0.1 and 1, the accuracy is better than .01%. Total resistance 100,000 ohms—applied input voltage 300V maximum. The assembly is specially aged for long-term stability.

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THE WAYNE KERR LABORATORIES LIMITED · NEW MALDEN · SURREY · MALDEN 2202

Model 1058 Single Beam Oscillograph

Designed for laboratory use, this new oscillograph provides a Y amplifier with a very useful frequency characteristic extending from d.c. to 6 Mc/s. The display is presented on a new post deflection accelerator tube at an amplitude of not less than 6 cm over the stated frequency band. The maximum sensitivity of the channel is 0.25 V/cm and calibration is effected by means of the accurate test voltage provided. The time base of the instrument can be switched to fire repetitively from a trigger pulse of either sign derived from the Y amplifier signal or externally. A special refinement, of interest to the Television Engineer, is the provision for triggering from the Frame or Line sync. pulse in a 1 volt D.A.P. (positive) composite video signal. Five calibrated time base ranges are provided giving spot velocities from 30 cm/sec to 1.5 cm/microsec. An X amplifier with a maximum sensitivity of 0.5 V/cm and bandwidth 20 c/s—250 kc/s (—50%) is included and allows time base expansion, continuously variable, of up to five times. Time measurement is by calibrated shift control. The instrument operates from 100—130 or 200—250 volt mains supplies.

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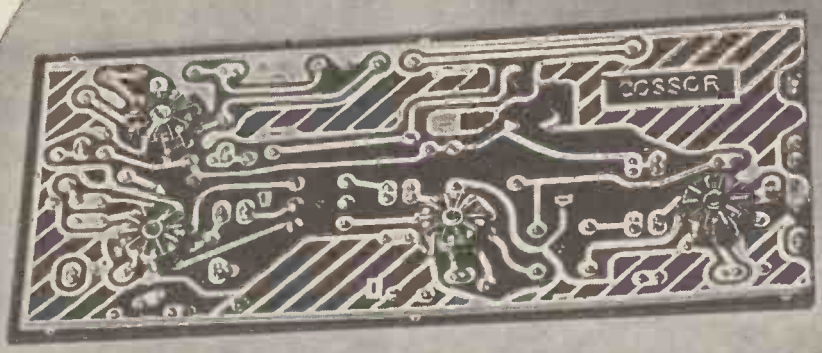

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COSSOR

Cossor engineers will be pleased to advise on designs for printed components and circuit assemblies, and complete layout designs.

Cossor printed circuit and wiring panels are subject to the most rigorous humidity and electrical tests prior to final approval by our Design and Development Section.

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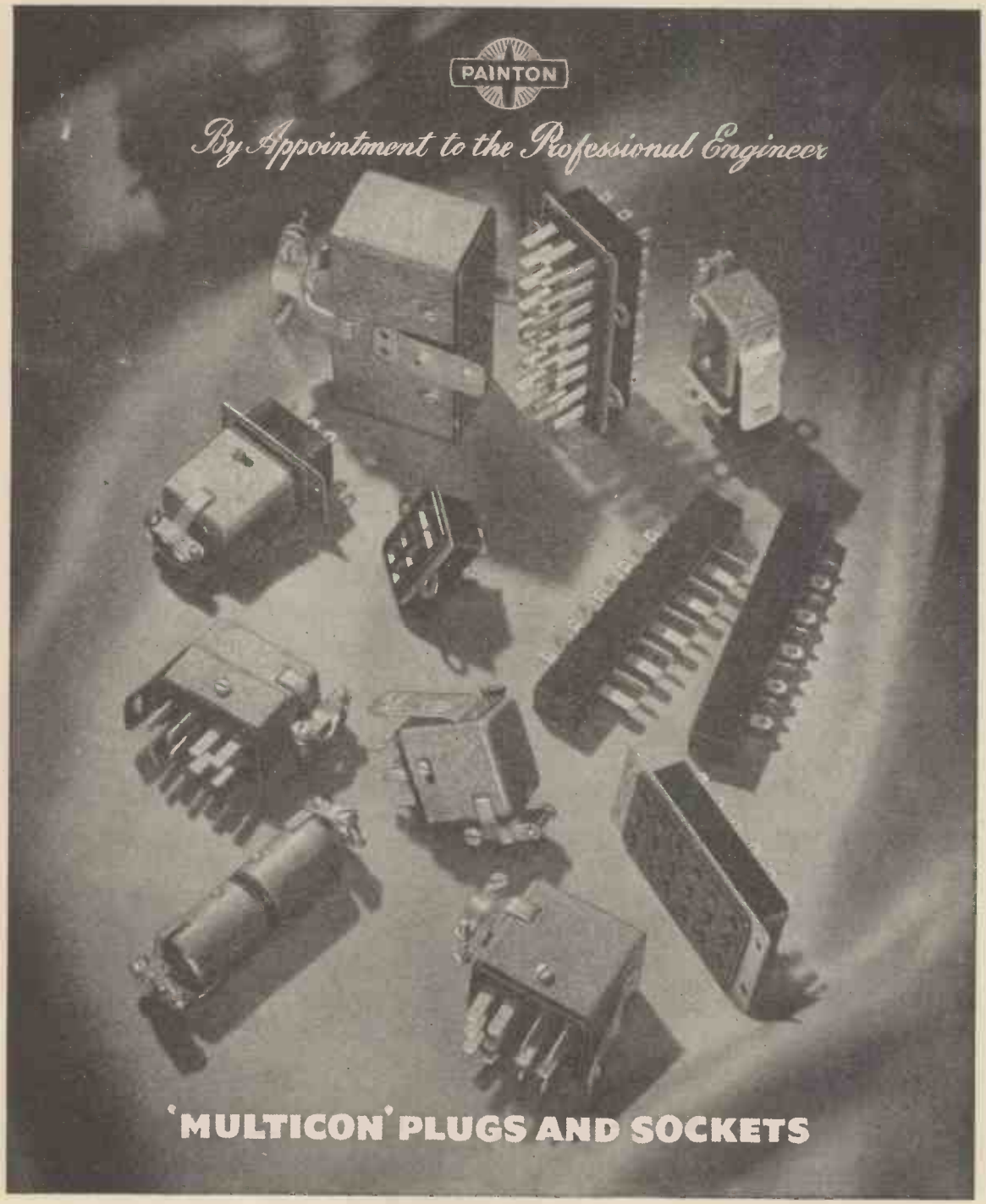

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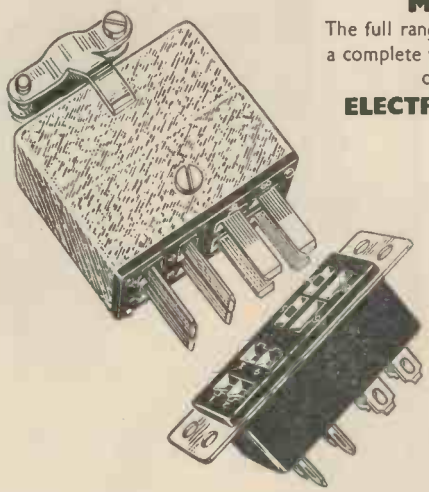
By Appointment to the Professional Engineer

'MULTICON' PLUGS AND SOCKETS

The full range consists of 2, 4, 6, 8, 10, 12, 18, 24 and 33-pole sizes, and there is a complete variety of Plugs and Sockets with alternative mounting arrangements, cable-fixings, retaining devices and cover earthing facilities.



ELECTRICAL SPECIFICATION AND PERFORMANCE

VOLTAGE RATING 1. Working Voltage :	(a) 1,000 Volts D.C. or A.C. (peak). This applies to use in temperate climates under normal conditions. (b) 500 Volts D.C. or A.C. (peak). This applies to tropical use.
2. Voltage Proof :	All plugs and sockets will withstand a voltage proof test of 2.5 KV between contacts, and 3.0 KV between contacts and the mounting flange or cover.
3. Breakdown or Flashover Voltage :	The breakdown voltage is approximately 3.3 KV. The properties of the mouldings are such that even after flashover there is no evidence of tracking, and the plugs and sockets will still withstand the Voltage Proof specified above.
CURRENT RATING	5 Amps. D.C. or A.C. (R.M.S.) per contact.
CONTACT RESISTANCE	1. Average Contact Resistance : Below 0.002 Ohm. 2. Maximum Contact Resistance : 0.0025 Ohm.

DESIGN FEATURES

(1)
The terminal numbering is moulded into both the plug and socket bodies, and appears not only in proximity to the appropriate soldering-tag, but also on the mating face.
This not only facilitates wiring, but enables complete cable forms to be tested prior to inclusion in equipments without removing the plug socket or covers.

(2)
Four small distance pips are moulded on to the plug body and they keep the mating faces slightly apart even when the plugs and sockets are fully engaged.
This eliminates the possibility of free moisture remaining between the plug and socket face, and is instrumental in the superior tropical performance of "Multicon" plugs and sockets.

(3)
The single-piece body mouldings are nylon-filled *to provide a high insulation and tracking resistance.*

(4)
All socket clips and plug blades are located in recessed cavities in the mouldings.
This also provides a high tracking resistance between contacts, and, in the socket version, the enclosed contacts enable the maximum voltage to be safely utilised (provided the direction of voltage supply feed is from socket to plug).

(5)
Each socket clip has split limbs, so that there are four individual areas in contact with each plug blade.
This ensures absolute reliability of contact, with a minimum life of 10,000 operations at low and constant contact resistance.

(6) Panel or chassis mounting flanges are available with side or end fixing holes. Cut-out information given relates to Panel thicknesses up to $\frac{3}{32}$".
This enables rows of plugs or sockets to be mounted either end-to-end or side-by-side with a maximum saving in panel or chassis space.

(7)
In the 24 and 33-pole sizes the plugs are normally supplied with a large pin locator, which is also an electrical contact.
This is provided to facilitate the engagement of these larger sizes, especially in unitor applications.

(8)
Covers are provided with either a top cable-entry hole and clamp or a side cable-entry hole and clamp, *to suit the needs of particular equipments and designs.*

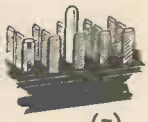
(9)
Two alternative facilities can be provided for earthing the plug or socket covers.
A.
In one version an earthing tag attached to the moulding connects the inside of the cover to the highest numbered contact so that an earth lead in the cableform, connected to the highest numbered contact, automatically earths the cover.
B.
In the alternative form, an earth tag is rivetted directly to the outside of the cover and is suitable for the direct connection of an earth lead.
By either method the cover is earthed to ensure the safety of the users of equipments in which "Multicon" plugs and sockets are incorporated.

(10)
All sizes of plug or socket covers can be fitted with retaining blades to secure the unit to the panel or chassis.
Even under the most severe vibration conditions, therefore, or in the case of accidental interference with the cableform, there is absolute reliability of contact.

(1)

(2)

(5)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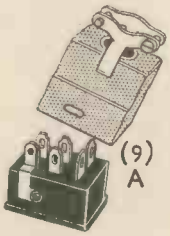
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(9B)

(10)

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OG3
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OZ4A
OZ4G
1A3
1A5G
1A5GT
1A7G
1A7GT
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1AC6
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1AH5
1AJ4
1B3GT
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1B26
1B27
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1C5GT
1CP1
1D5
1D6
1D8GT
1D13
1E4
1E7G
1E7GT
1F1
1F2
1F3
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1G6GT
1H5G
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1H6G
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1K7G
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1LA4
1LA6
1LC6
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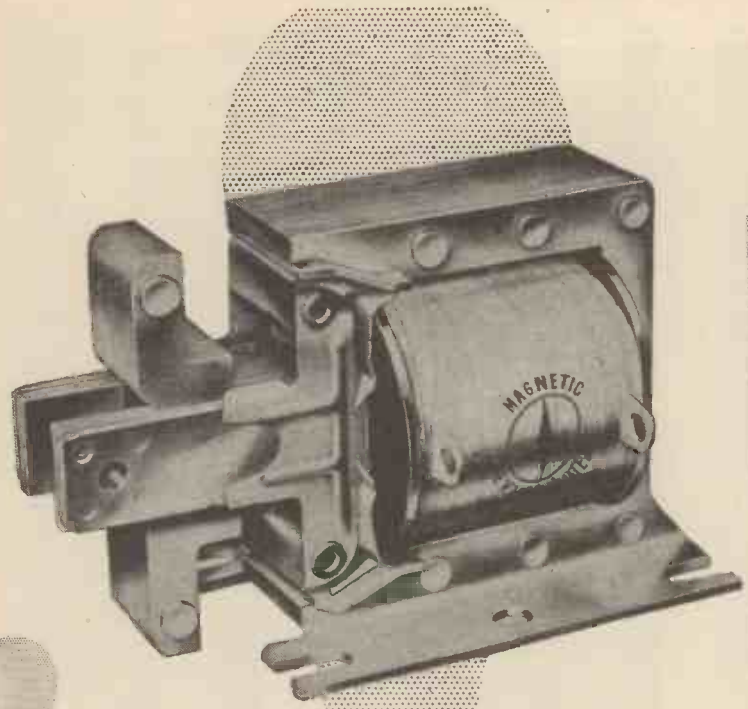

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MD 138

The Marconi TF 801B/1 Signal Generator

Marconi's new "/1" version of the TF 801B is now in production. It is a premium-grade instrument meeting all signal generator requirements for the design, manufacture and maintenance of a.m. equipment in the range 12 to 470 Mc/s.

Painstaking attention to detail in the design of the master oscillator and power amplifier circuits has yielded an instrument with an r.f. output of unusually high quality: f.m. on a.m. is less than 2 kc/s at all carrier frequencies up to 425 Mc/s; harmonic content is less than 2%; the calibration of the frequency dial is accurate to within 0.5%; drift is less than 0.02% over a 10-minute interval.

ABRIDGED SPECIFICATION

Frequency Range: 12 to 470 Mc/s in five bands.

Output: 0.1 μV to 1 volt modulated; 0.1 μV to 2 volts unmodulated.

Source Impedance: 50 ohms.

Internal Modulation: 1000 c/s sine a.m. monitored and variable to depths up to 90%.

External Modulation: Sine up to 20 kc/s or pulse at p.r.f's. up to 50 kc/s.

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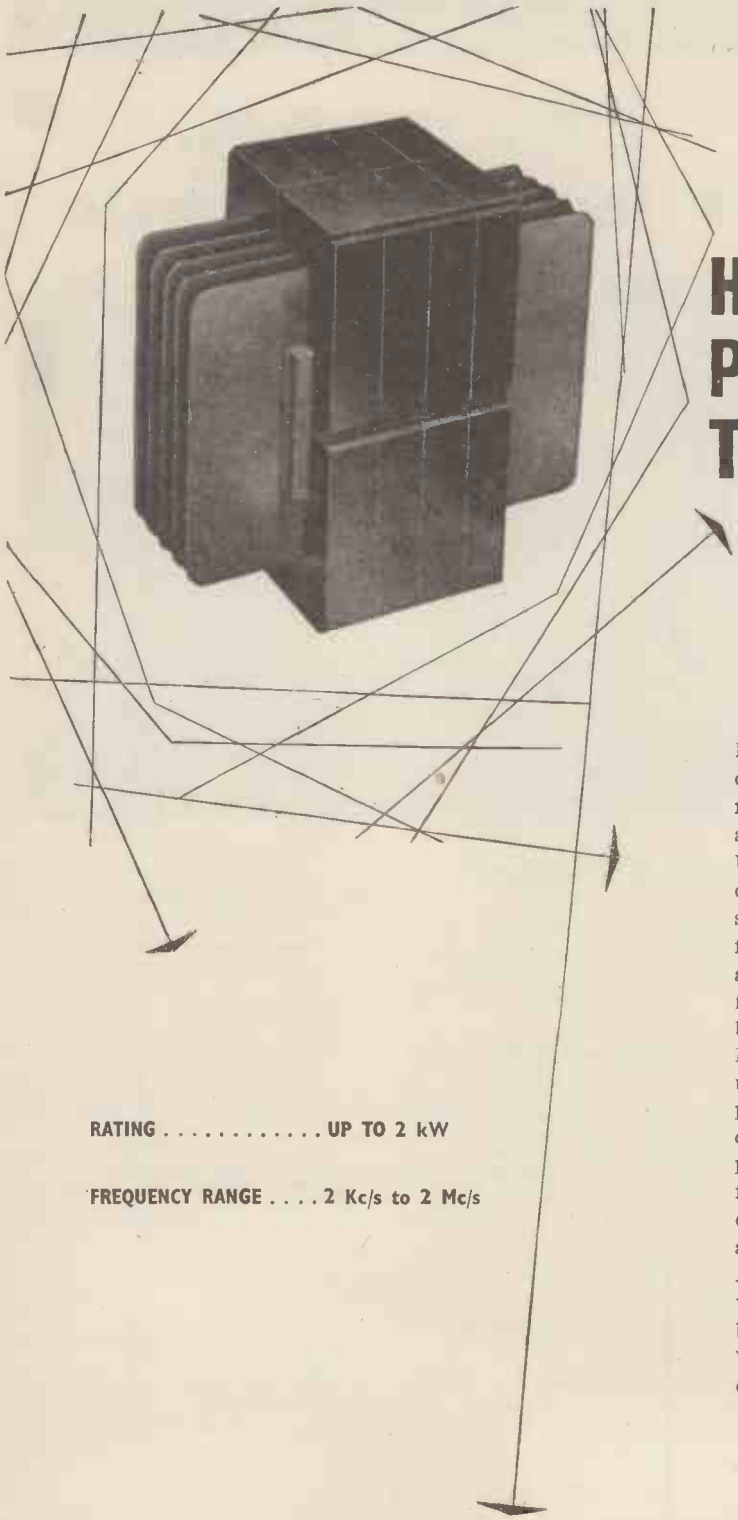

H.F. POWER TRANSFORMERS

H.F. power transformers of outstanding efficiency are the latest additions to the Mullard range of high quality components designed around Ferroxcube magnetic cores.

Utilising the unique characteristics of Ferroxcube to the full, Mullard H.F. transformers are smaller, lighter, and less costly than transformers using alternative core materials. These advantages are particularly marked in transformers required to handle powers of up to 2kW, between the frequency range 2kc/s to 2Mc/s.

Mullard transformers are already finding wide use in applications as diverse as ultrasonic H.F. power generators and aircraft power packs operating from an aircraft's normal A.C. supply. In the latter application, the low leakage field of Ferroxcube can eliminate the need for external screening, thereby reducing the size and weight of the transformer even further.

As with all Mullard high quality components, these H.F. power transformers are designed and built to engineers' individual specifications. Write now for details of the complete range of components available under this service.

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FREQUENCY RANGE . . . . 2 Kc/s to 2 Mc/s

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Magnadur ceramic magnets
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0·03 c/s–30 c/s
V.L.F. SIGNAL GENERATOR

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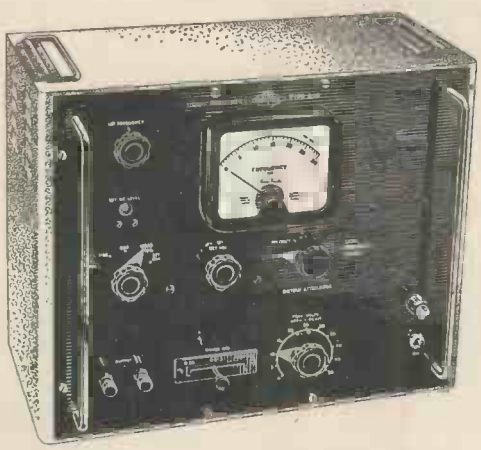

Type 852

FREQUENCY RANGE
0.03 c/s–0.3 c/s.
0.3 c/s–3 c/s.
3 c/s–30 c/s.

HARMONIC DISTORTION
Less than 2%.

OUTPUT LEVEL
500 microvolts–50 volts.

NORMAL OUTPUT IMPEDANCE
10k ohms.

LOW OUTPUT IMPEDANCE
150 ohm from a cathode follower.

THE NEW Airmec Signal Generator Type 852 produces a sinusoidal signal continuously variable from 500 microvolts to 50 volts peak with small distortion over the frequency range 0.03 c/s to 30 c/s.

A variable speed motor used in conjunction with a three-speed gear box drives a specially designed modulating capacitor which modulates a high frequency signal. The modulated signal is rectified and amplified in a direct coupled amplifier employing negative feedback. The output frequency is adjusted by varying the speed of the D.C. motor and is indicated on the dial of a 6in. meter.

Since the frequency of the output signal does not depend upon the use of very high value resistors or capacitors, a good long term stability is obtained.

QUICK DELIVERY
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For greater convenience and vastly improved performance, get 'SCOTCH BOY' *Extra Play* magnetic recording tape, No. 150. The new polyester base film is one-third thinner — *and still it is stronger!* — than other bases. That is why a reel carries half as much tape again, and gives you 50% EXTRA PLAYING TIME . . . 1800 feet of tape instead of the usual 1200 on a 7″ reel!

The specially developed oxide coating of 'SCOTCH BOY' 150 tape is also thinner than usual. This new, potent coating gives exceptionally crisp and clear reproduction. Response to the higher frequencies is particularly improved.

'SCOTCH BOY' *Extra Play* 150 tape is limp, flexible, strong, and easy to handle. It hugs the contours of recording heads, winds trimly, and tracks smoothly. It has an indefinite life in storage and is the ideal tape if you are an archivist.

'SCOTCH BOY' 111, *acetate-base tape, world-famous for faithfulness and clarity, is still available, of course, in lengths up to 1200 feet.*

GO FOR THE TAPE THAT GIVES YOU BETTER PERFORMANCE AND *50% EXTRA PLAYING TIME*

SCOTCH BOY extra play

REGD. TRADE MARK

MAGNETIC RECORDING TAPE 150

with polyester base

PRODUCT OF 3M COMPANY RESEARCH

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Printed Circuit Connectors in high grade black moulded bakelite.

Six, twelve or eighteen way.
Specially designed not to damage printed circuit foil.
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Current carrying capacity : 5A.
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This unit is designed to give good quality at domestic volumes, it can be operated successfully in conjunction with a normally good receiver.

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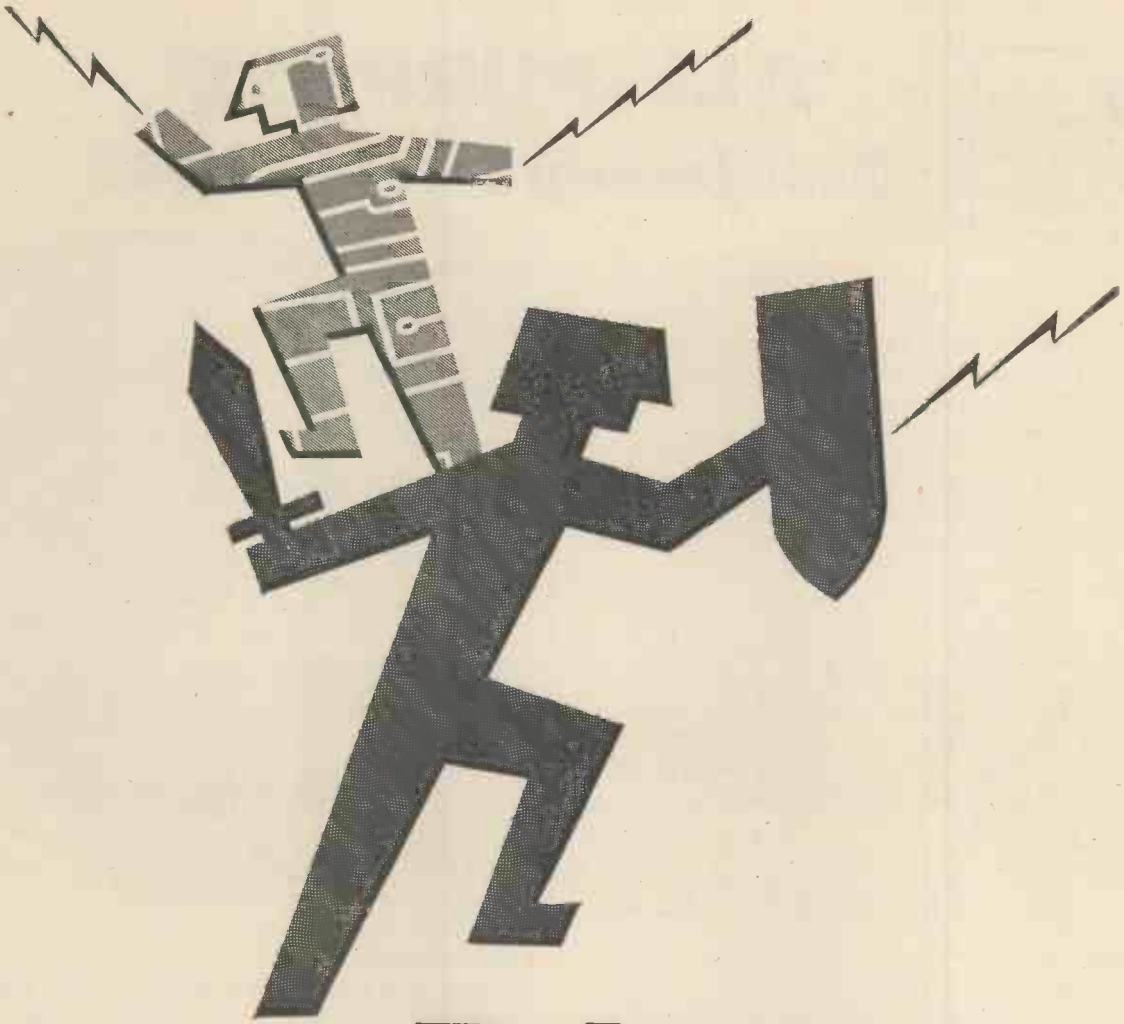

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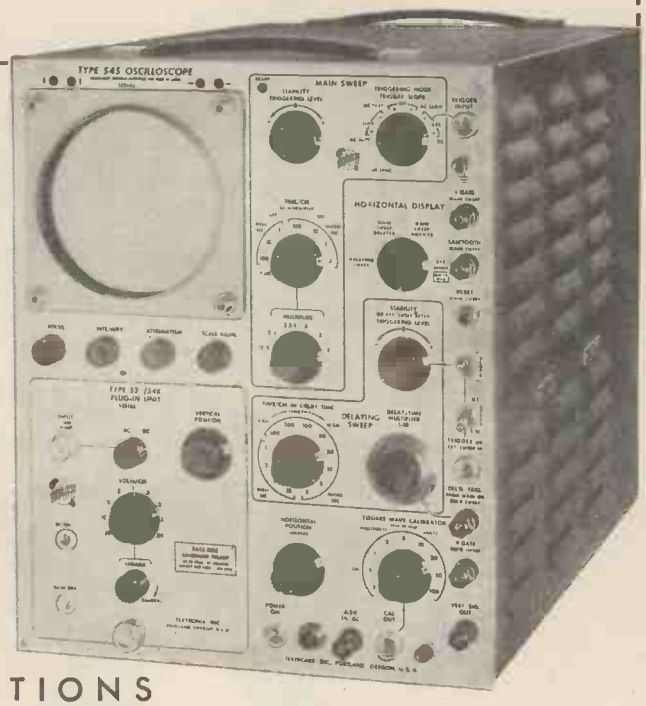
DELARON' is a registered trade mark

"ALL-PURPOSE" Oscilloscope...Type 545



The Tektronix Type 545 is a "fast-rise" oscilloscope with high-performance characteristics. It can write the answers to the most difficult problems in high-speed pulse analysis on its screen. You have only to read them off . . . with full assurance of their accuracy.

But the Type 545 is not a specialized instrument, useful only in fast-rise applications. It is easily adapted to a multitude of other applications by inexpensive plug-in preamplifiers. Along with its unique sweep-delay facility, this plug-in feature helps make the Type 545 the most versatile oscilloscope you ever hoped for. Is the Type 545 the answer to your instrumentation problem?

MAJOR SPECIFICATIONS

Sweep Range

0.02 μsec/cm to 12 sec/cm.
24 calibrated steps from 0.1 μsec/cm to 5 sec/cm.
24 additional calibrated steps with accurate 5x magnifier.
Calibration accuracy within 3%.

Sweep Delay

Conventional, or triggered jitter-free delay 1 μsec to 0.1 sec in 12 calibrated ranges.
Range accuracy within 1%, incremental accuracy within 0.2% of full scale.

Versatile Triggering
10-KV Accelerating Potential
Square-Wave Amplitude Calibrator
Balanced 0.2 μsec Delay Network
DC-Coupled Unblanking
Electronic Voltage Regulation

Vertical Response

With Type 53/54K Unit plugged-in — dc to 30 mc, risetime 12 millimicroseconds, sensitivity 0.05 v/cm to 20 v/cm in 9 calibrated steps, input capacitance direct — 20 μμf, with 10x probe — 8 μμf, with 50x probe — 2.5 μμf.

***Type 53/54K Fast-Rise Unit . . . . . $125 (48£)**

OTHER PLUG-IN PREAMPLIFIERS

***Type 53/54C Dual Trace DC Unit . . . . $275 (106£)**

***Type 53/54D Differential High-Gain DC Unit . . . . $145 (56£)**

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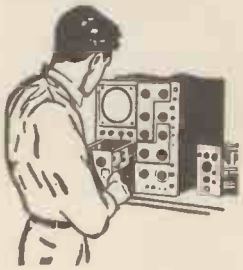
***Type 545 — $1450 (558£)**
plus price of desired plug-in units.



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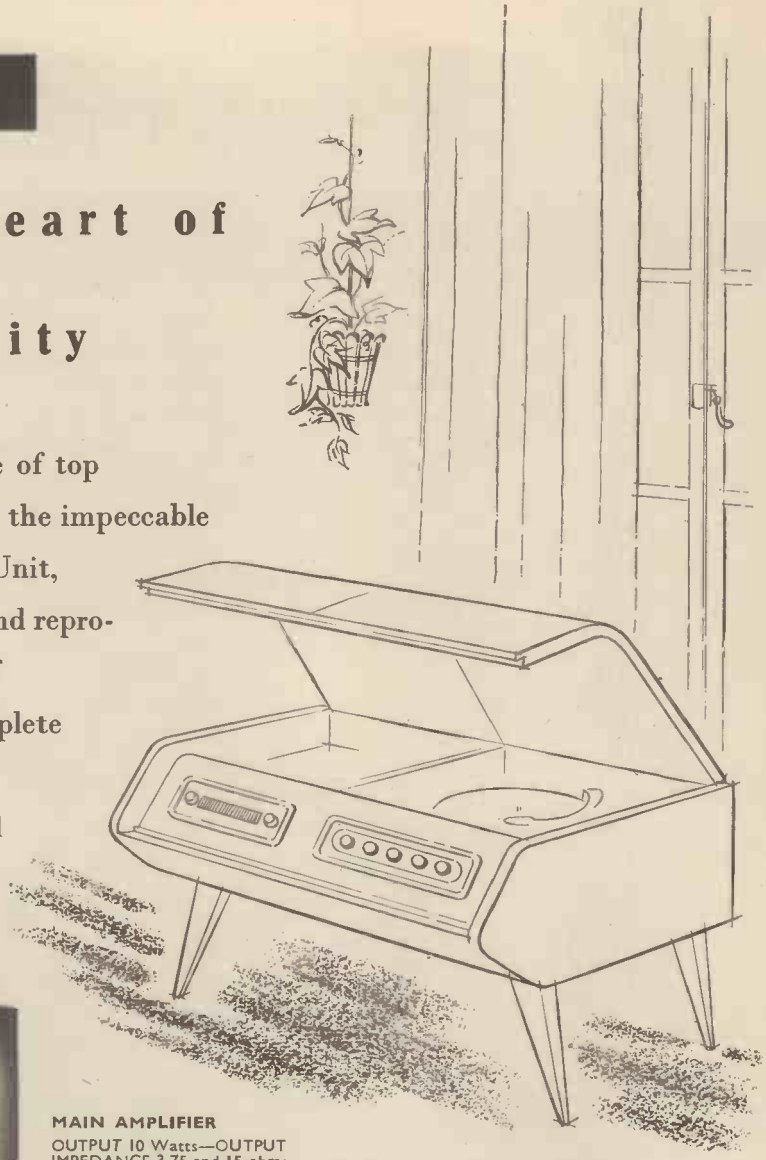

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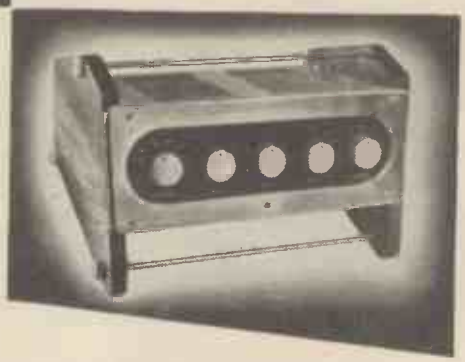

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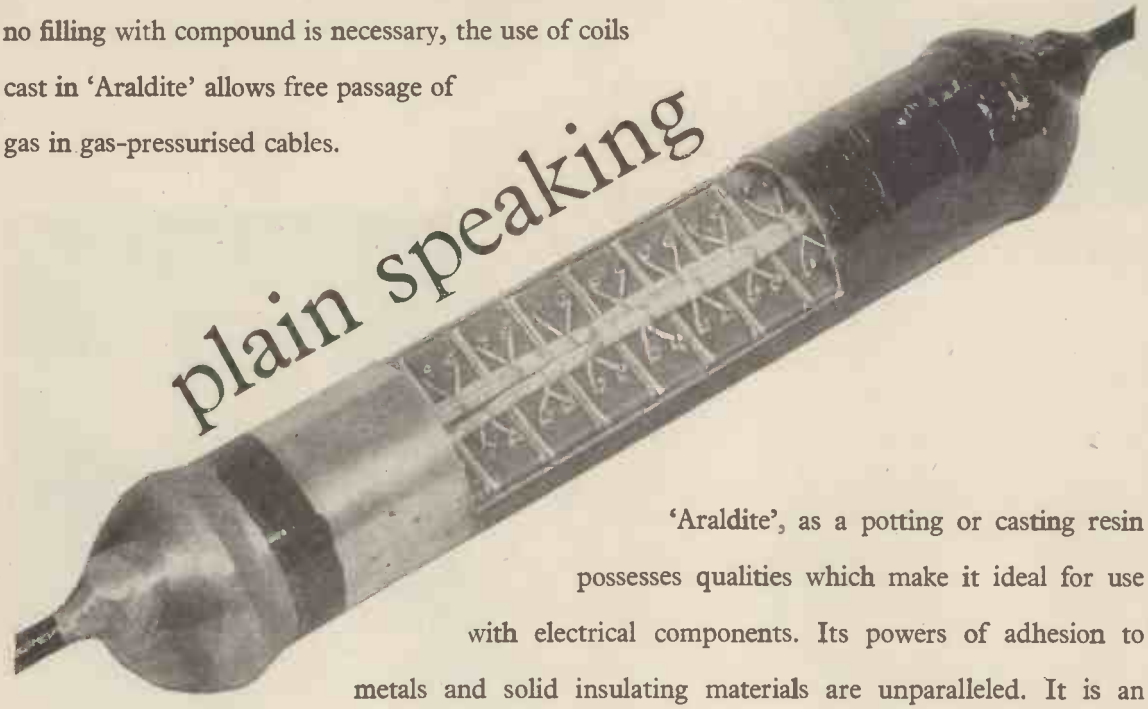

'Araldite', as a potting or casting resin possesses qualities which make it ideal for use with electrical components. Its powers of adhesion to metals and solid insulating materials are unparalleled. It is an excellent insulator, tough, flexible, highly resistant to 'tracking' and has a low power factor. It does not cause corrosion, provides complete protection against tropical conditions and complies with service requirements relating to sealing of components.

'Araldite' epoxy resins have a remarkable range of characteristics and uses.

They are used
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Please write now for full descriptive literature on Araldite Epoxy Resins.

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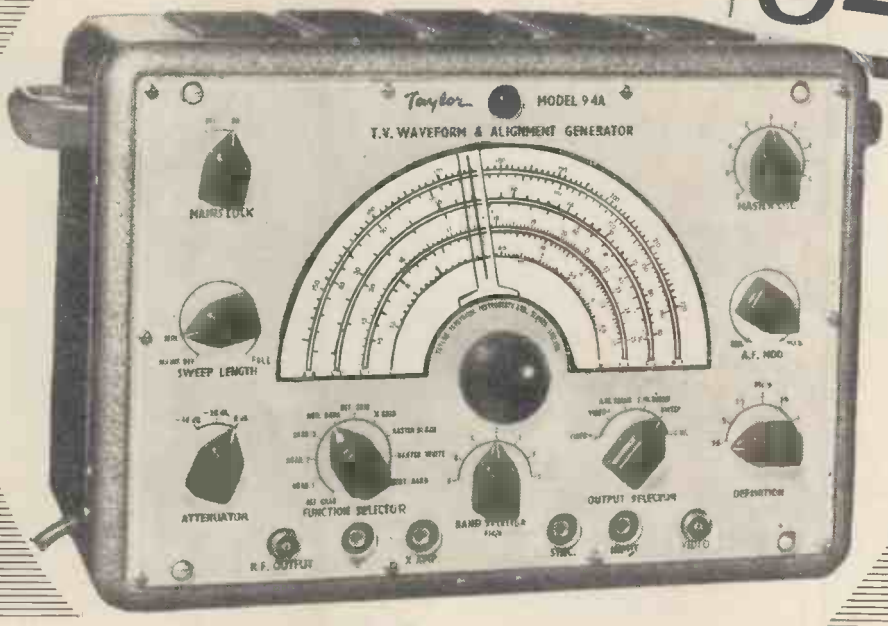
T.V. Waveform & Alignment Generator

MODEL 94A



for all T.V. systems

(1) T.V. Pattern Generator.
(2) A.M. Signal Generator with variable audio output.
(3) F.M. Signal Generator.
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4 BASIC INSTRUMENTS INCORPORATED IN ONE

7 expanded bands cover frequencies:

(1) 4 to 7 Mc/s.
(2) 8 to 14 „
(3) 15 to 22 „
(4) 30 to 45 Mc/s.
(5) 45 to 80 „
(6) 85 to 145 Mc/s.
(7) 150 to 230 „

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T.V. PATTERN GENERATOR

Modulation. All patterns FULLY INTERLACED with accompanying line and frame blanking synchronizing (and equalizing on 625, 525 lines) signals. Three gradation patterns providing relatively high, medium and low frequency transients. Cross grid pattern for linearity checking. Cross bar pattern on which 1.5, 2, 2.5, 3, 3.5, 4, 4.5 Mc/s definition bars can be displayed. Horizontal bars. Vertical bars with switched Mc. bars. White raster. Black raster.

Output—R.F. Three position attenuator, 0, −20 and −40 db relative to 100 mV.

Output—Video. From cathode follower 2Kohms direct, positive or negative 3V peak to peak.

Output—Synchronizing. Additional sync. output from 2Kohms through 8μF 10V peak to peak positive going waveform comprising line and frame synchronizing pulses, interlacing signals (and equalizing pulses on 625 and 525 lines).

Audio. From cathode follower 2Kohms direct. Variable A.F. voltage at 900 c/s approx. 3V peak-to-peak maximum.

Optional mains lock facility.

Main features of A.M. Signal Generator F.M. Signal Generator & T.V. Sweep Oscillator:

Frequency: 4–230 Mc/s in 7 expanded bands. Calibration **accuracy:** ±1%. **Output:** A.M. 100 mV, F.M. and sweep 3 mV. **Attenuation:** 0, −20, −40 db. **Output impedance:** 75 ohms unbalanced. **Sweep frequency:** 50/60 cycles. **A.M. & F.M. audio modulation:** 900 c/s approximately sinusoidal. **A.M. modulation depth, F.M. deviation and sweep band-width** all controllable.

Power supply: 105/125 V. or 200/250 V. A.C., at 40/100 c/s. Consumption 70 watts.

Weight: 20lb. Dimensions: 17in. × 9in. × 8in. (43 × 23 × 20 cm.).

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PORTABLE TELEVISION OSCILLOSCOPE

- ★ **6 Mc/s BANDWIDTH Sensitivity 100 mV/cm.**
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- ★ **Fully enclosed. Stowage for leads in removable door.**
- ★ **Built-in Stand.**
- ★ **Weighs only 19 lbs.**

Here at last is the 'scope specially designed for the TV engineer. Small and light enough to carry around, its performance is far ahead of any other oscilloscope in its price class. It Incorporates an entirely new Miller-Multivibrator time base circuit with trace expansion continually variable to more than 20 cm. A 1 microsecond pulse can easily be opened out to 2 cm. The special sync. selector circuit facilitates solid synchronisation from small signals and provision is made to synchronise from the frame pulses in a complete TV Waveform. The signal amplifier has a Constant Bandwidth up to 6 Mc/s (3db) and a useful response to 10 Mc/s. Calibration allows accurate measurement of the applied signal. The Sensitivity is 100 mV per centimetre and a frequency compensated attenuator is incorporated. The horizontal amplifier terminals are brought out for use with a wobbulator.

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301 TRANSCRIPTION MOTOR

THE GARRARD MODEL 301 TRANSCRIPTION MOTOR

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The FIRST and ONLY Aerials with ELECTRONIC COUPLING

The HIL-O incorporates a completely new principle whereby the Band I Dipol Driven Element is "Electronically coupled" to a Band III Resonator (Prov. Pat. No. 21958/55). This eliminates the use of coupling bars, thus avoiding any impedance mis-match and at the same time has the advantage of utilising the Band I Elements on both Bands I and III. For example the HIL-O Model HL402/4K (Band I Dipole and Director electronically coupled to 4 Band III elements) has an equivalent Band III performance to a 6-element Aerial. This same principle is a feature of the complete HIL-O range.

1 Aerial only FOR BOTH BANDS

1 Junction Unit only

1 Down Lead only

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MODEL

HL402/4K

Band I "H" (Dipole and Director) Electronically coupled to 4 Band III elements for CHIMNEY MOUNTING.

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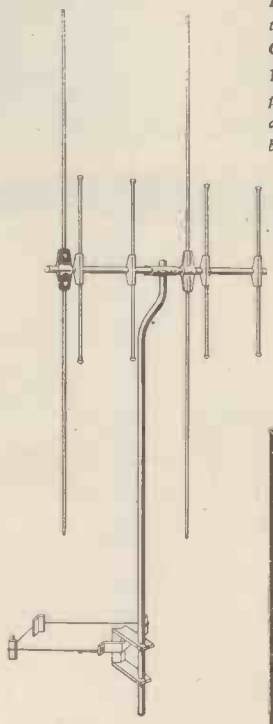
All Antiference Aerials incorporate features which are fully protected by Patents or are the subject of Patents applied for.



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- 1 JUNCTION UNIT ONLY.
- 1 DOWN LEAD ONLY.
- NO FILTER UNIT REQUIRED.
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- ALL CHANNEL COMBINATIONS.
- HIGHLY COMPETITIVE PRICE.

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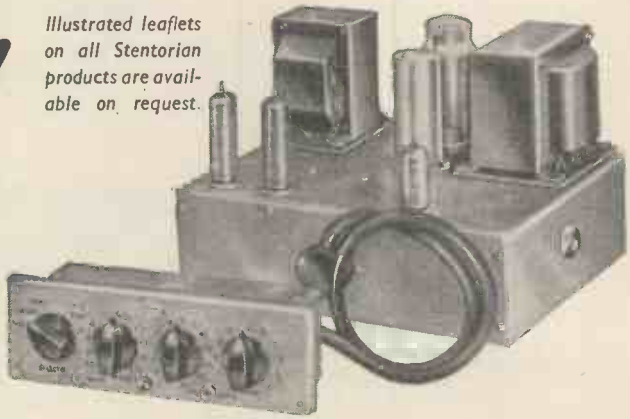
Stentorian

● There are now twelve models of the famous Stentorian High Fidelity Units with the patented cambric cone. The latest addition is the H.F. 1514 shown at left—a 15″ P.M. Unit, with 14,000 gauss magnet and mid-range frequency stabilisers. Handling capacity 25 w. Frequency response 25 c.p.s. to 4,000 c.p.s. Bass resonance 35 c.p.s. Price £24.10.0. The 10″ model (H.F. 1012) shown below costs £4.19.9.

● Above is the new T.816—an 8″ mid-range and high frequency unit with a handling capacity of 15 w. when used with a 1,500 c.p.s. cross-over. Price £6.10.0. Tweeter Units are available at £4.4.0 and £12.12.0, the latter (T. 12) being illustrated at right.

Illustrated leaflets on all Stentorian products are available on request.



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W B

STAND 47

& D19 AND D21

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A very high quality Cabinet in a modern design. Exterior veneered in a highly figured Walnut. Solid block-board lift-up top with all interiors veneered in Sycamore. Full silk front. 27in. x 16in. x 32in high.
CASH ONLY **£8**

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Superhet. Chassis of Latest Design and Technique. General Specifications applicable to all models

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CAT. NO. CR/A: 5-valve Superhet, 3 wavebands. **12 Gns.**
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CAT. NO. CR/AFM47: 7-valve Superhet with F.M./VHF Band (4 wavebands) **23½ Gns.** Or on Credit Terms.
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CAT. NO. CR/AFM49/PP: 9-valve Superhet with F.M./VHF Band (4 wavebands). Push-pull output including 2 loudspeakers. CASH **26 Gns.** Or on Credit Terms.
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★ CABINET CAT. NO. CAB/02

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★ F.M./VHF TUNERS

Self powered. Six valves with grounded grid RF stage followed by additive mixture using a FCC85 twin triode in sealed permeability tuned unit. Two I.F. stages ensure maximum gain with 6AL5 double diode as ratio detector. Frequency coverage of 85-101 megacycles allows adequate overlap. Very finest quality throughout.

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Complete Unit in Cabinet with Magic-eye tuning. Boxed, 13in. long x 6½in. overall depth x 7½in. high (approx.). **17 Gns.**
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Chassis only excluding magic-eye. Unboxed, 11¾in. long x 5¾in. overall depth x 4in. high.
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★ Loudspeakers, Gram Amplifiers, Tape Recorder equipment, etc., available at keenest prices.
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Or on Credit Terms.
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Specially designed for the amateur builder, these Disc Players consist of the latest four-speed Automatic Record Changers, complete with crystal turnover pick-up head for long-playing and standard records, mounted on sycamore-lined base. Supplied complete with fitted mains lead and screened pick-up lead, ready for connecting up.
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★ AUTOMATIC RECORD CHANGERS

All automatic Record Changers are of the latest type and unused.

CAT. NO. RC/A: This is the latest multi-speed changer incorporating 16 r.p.m. for "talking-books," and arrangement for manual control. Fitted with high fidelity Crystal Turnover Pick-up Head. A.C. mains 200/250 volts, 50 cycles only. CASH **£9.15.0**
Packing and carriage 12/6.

CAT. NO. RC/B: Latest Garrard RC88 model, fitted with GC-2 Crystal Turnover Pick-up Head. A.C. 200/250 volts, 50 cycles. **£13**
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by J. Christopher Heal F.S.I.A.

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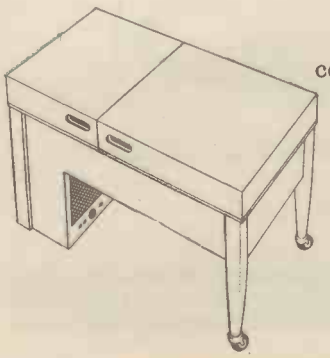

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or through your local Hi-Fi suppliers

ACOUSTICAL MANUFACTURING CO LTD

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Type GB 896
(A.R.B. Ref. No. E3518)
For loads from 2 to 35 lbs.

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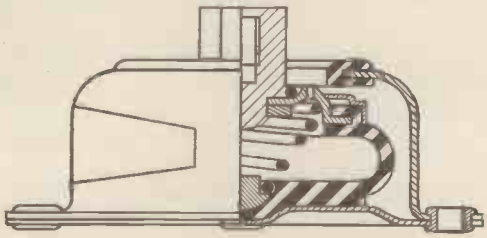

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Acoustical Quad F.M.	30 9 0	74/5	15 4 6	28/3	21 0 0
Armstrong 105 AM/FM	37 0 0	90/6	18 10 0	34/4	26 1 2
Armstrong F.C.48	25 2 0	61/4	12 11 0	23/5	17 8 9
Leak TL10 and Point One	28 7 0	70/4	14 3 6	26/3	28 7 0
Rogers RD Junior	26 0 0	63/7	13 0 0	24/2	26 0 0
W.B. 12 Hi-Fi	25 0 0	61/1	12 10 0	23/4	25 0 0
E.A.R. Mullard 510	18 18 0	46/5	9 9 0	18/3	18 18 0
Loudspeakers					
Wharfedale W15CS	17 10 0	42/9	8 15 0	17/1	17 10 0
,, Super 12CSAL	17 10 0	42/9	8 15 0	17/1	17 10 0
,, W12CS	10 5 0	26/1	5 2 6	11/-	10 5 0
,, Golden 10	8 0 11	21/3	4 0 6	9/2	5 15 0
,, Super 8CSAL	7 6 11	19/8	3 13 6	8/7	5 5 0
G.E.C. Metal Cone	9 5 0	23/11	4 12 6	10/2	6 13 7
Goodmans 150 Mk. II	10 15 9	27/4	5 8 0	11/6	10 15 9
,, Axiom 80	24 4 9	59/3	12 2 6	22/8	17 10 0
,, Audiom 60	9 2 9	23/8	4 11 6	10/1	9 2 9
,, Axiom 22	15 9 0	35/6	7 14 6	15/4	15 9 0
,, Axiom 102	10 7 9	26/5	5 4 0	11/2	7 10 0
Tuner and Radio Chassis					
Chapman S5 or S5 Export	22 8 0	54/9	11 4 0	21/2	16 0 0
,, S6BS (Bandspread)	46 4 0	112/8	23 2 0	42/10	33 0 0
,, S5 or S5E (F.M.)	34 2 6	83/5	17 1 3	31/7	24 7 6
,, F.M.81 Mk. II	22 1 0	54/-	11 0 6	20/10	15 15 0
,, F.M.82 (powered)	25 4 0	61/11	12 12 0	23/6	18 0 0
R.G.1 8 valve R'gram Chassis	23 2 0	51/4	11 11 0	19/3	17 10 0
Gramophone Motor Units					
Garrard RC98 Changer	19 7 7	47/4	9 13 9	18/8	14 6 0
Garrard RC120M	12 12 4	31/4	6 6 2	13/-	9 1 6
Collaro RC54 Changer	13 17 0	34/1	6 18 6	14/-	10 0 0
,, 2010 and Pickup (T)	19 10 0	47/8	9 15 0	18/11	14 1 6
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Connoisseur Variable (T)	28 11 4	71/-	14 5 8	26/6	20 0 0
Garrard 301 (T)	26 8 2	66/7	13 4 1	24/6	19 0 0
Pickups with L.P. and Std. Heads					
Decca X.M.S. (complete)	6 15 7	18/5	3 7 10	8/2	4 17 6
Connoisseur Diamond Styli	23 1 0	56/4	11 10 6	21/8	15 7 0
,, Sapphire Styli	13 1 3	32/4	6 10 8	13/5	7 11 0
Leak Diamond and Transformer	21 19 9	53/9	11 0 0	20/10	16 0 0
Tape Recorders and Decks					
Editor 2-speed Standard L.P. Tape	50 8 0	123/3	25 4 0	46/8	50 8 0
Editor Super Hi-Fi	65 2 0	159/1	32 11 0	60/4	65 2 0
Playtime (complete)	31 4 6	76/4	15 12 6	29/-	31 4 6
Playtime Plus	36 15 0	89/10	18 8 0	34/-	36 15 0
Vortexion 2A	84 0 0	205/4	42 0 0	77/10	84 0 0
,, 2B	99 0 0	242/-	49 10 0	91/9	99 0 0
Ferrograph 2A/N or 2A/NL	79 16 0	195/1	39 18 0	74/-	79 16 0
Ferrograph 2A/NH	90 6 0	218/6	45 3 0	83/8	90 6 0
Collaro Tape Transcriptor	20 0 0	48/11	10 0 0	19/2	20 0 0
Wearite 2A Tape Deck	35 0 0	85/7	17 10 0	32/5	35 0 0
Truvox Mk. IIIU Deck	24 3 0	59/1	12 1 6	22/8	24 3 0
Lane Mk. VI Deck	18 10 0	45/3	9 5 0	17/11	18 10 0
Microphones					
Acos Mic-16 (30/10,000)	12 12 0	31/4	6 6 0	13/-	12 12 0
Lustraphone VR53 Ribbon	9 19 6	25/6	4 19 9	10/10	9 19 6
,, LFV Tubular Dynamic	8 18 6	23/2	4 9 3	9/11	8 18 6
Microphones (Ronette) MADE IN HOLLAND					
RFC Studio	8 15 0	22/9	4 7 6	9/9	8 15 0
,, ,, low impedance	10 10 0	26/8	5 5 0	11/3	10 10 0
R572 Twin Microcell	9 19 6	25/6	5 0 0	10/10	9 19 6
R572L ditto low impedance	11 19 6	29/11	6 0 0	12/6	11 19 6
R474 Studio Multicell	15 15 0	38/5	7 17 6	15/7	15 15 0
Miniweight	3 12 0	11/4	—	—	3 12 0
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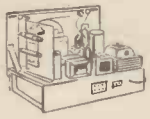

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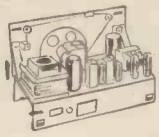
Tuner chassis
Self-powered
£20.17.0 *Including P.T.*



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with B.S.R. latest model Monach 4-speed automatic record changer with crystal pick-up.
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Ideal for tape recording.
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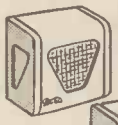

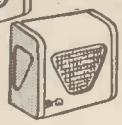

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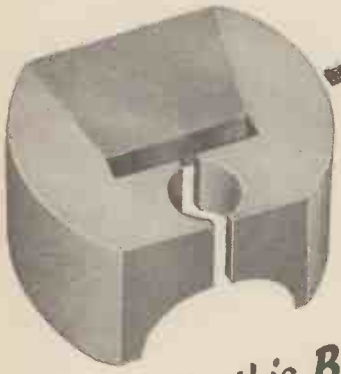

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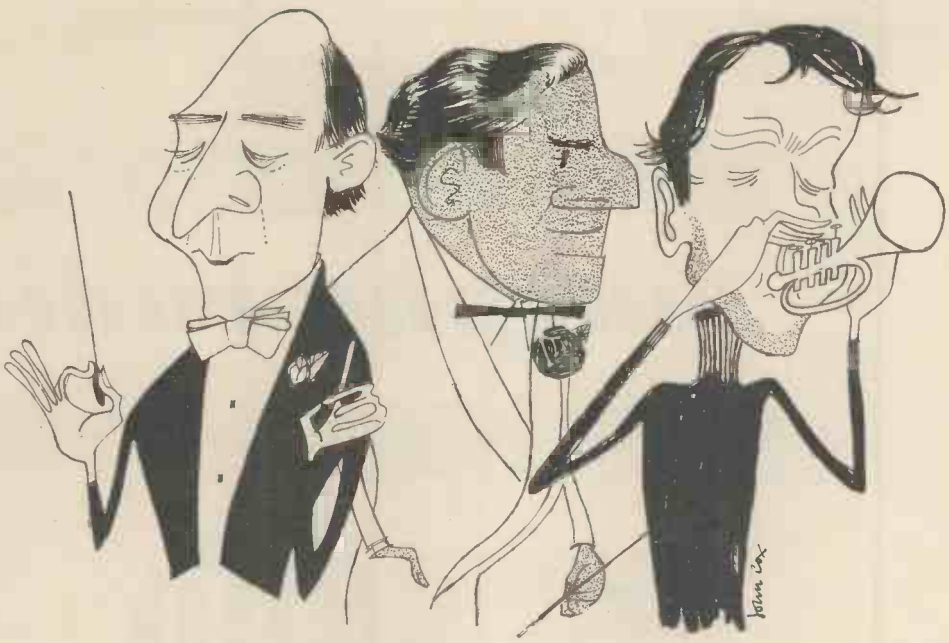

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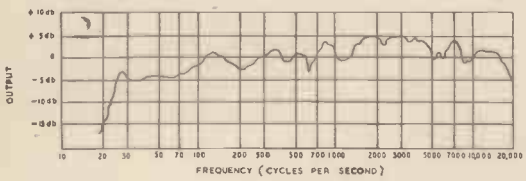

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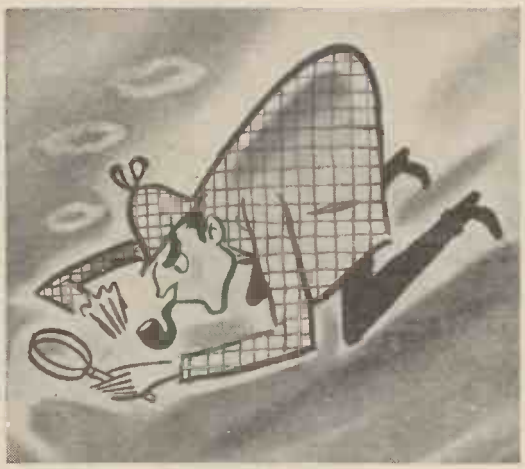

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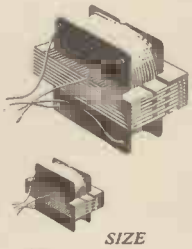
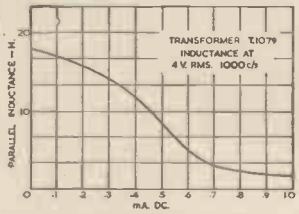


SUB-MINIATURE TRANSFORMER



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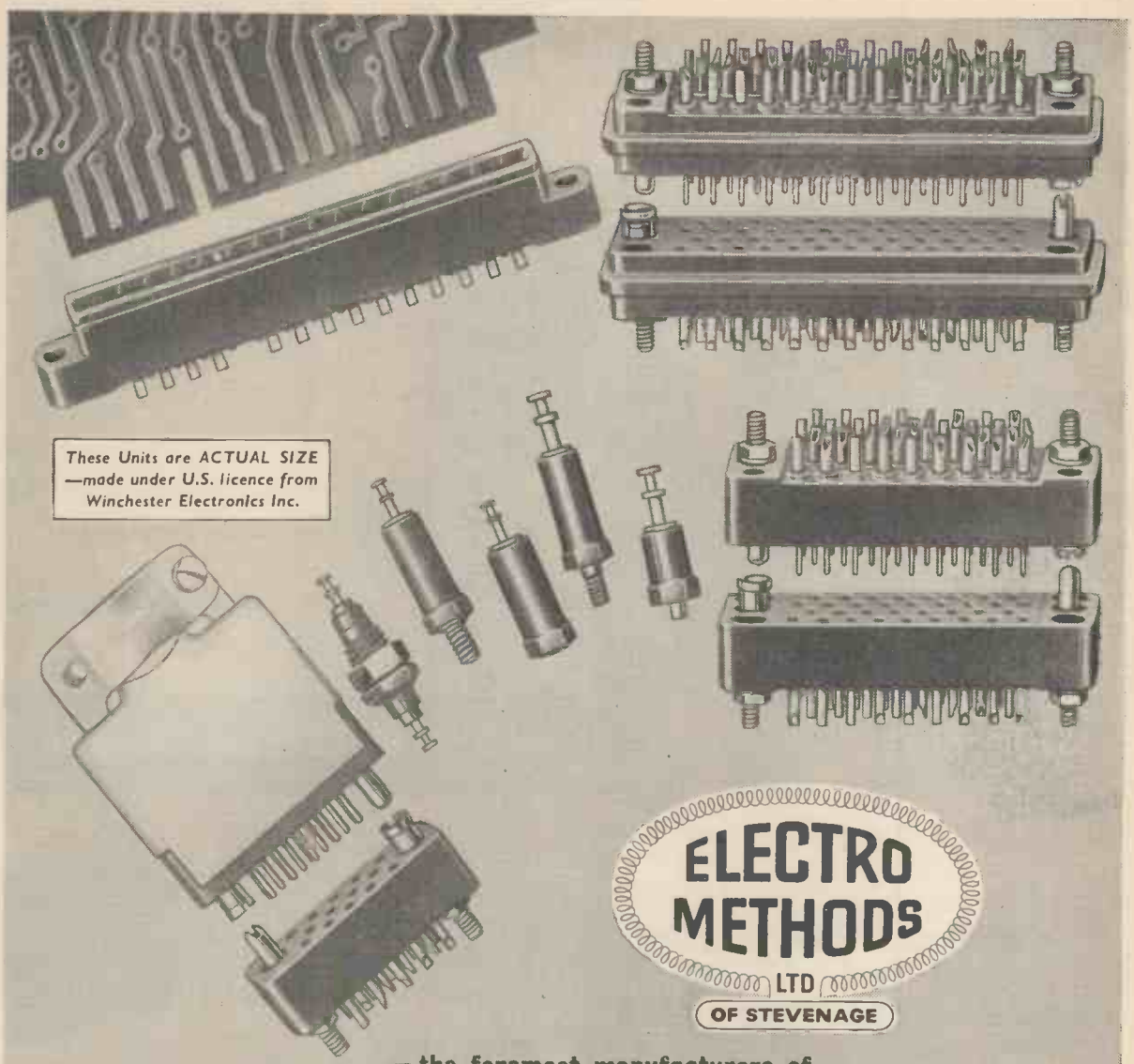

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● Bass and Treble Speakers with Crossover Network ● 8-watt Push-pull amplifier ● High Fidelity auto-changer with Studio Turnover Crystal Pick-up ● The latest in gramophone technique

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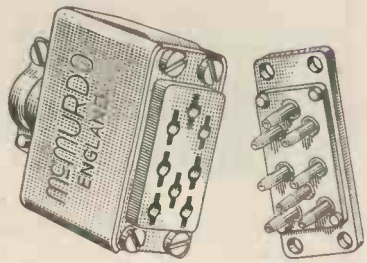
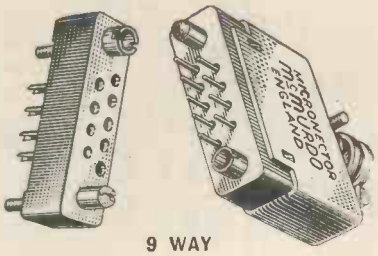


8 WAY



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★ STANDARD CONNECTORS

in 8, 12, 18 and 25 way
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Natural colour Nylon-PF moulding
Silver plated contacts
Breakdown voltage 3.5 KV

★ MICRONECTOR

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McMURDO *connectors*

Covers can be supplied for either plugs or sockets or both in all these types.

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Inexpensive flat connector for Printed Circuits
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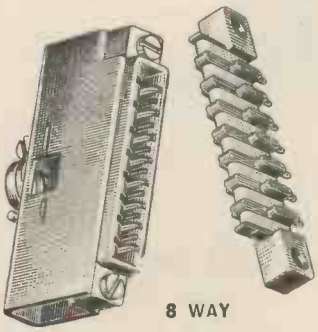

8 WAY

★ RED-RANGE CONNECTORS

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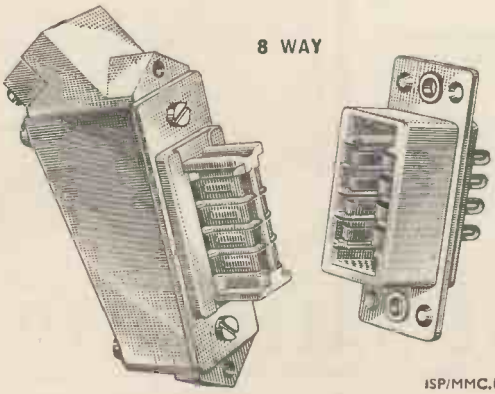
Medium priced
Low insertion force — self-aligning
Red Nylon-PF moulding
Gold plated contacts
Breakdown voltage 3.0 KV



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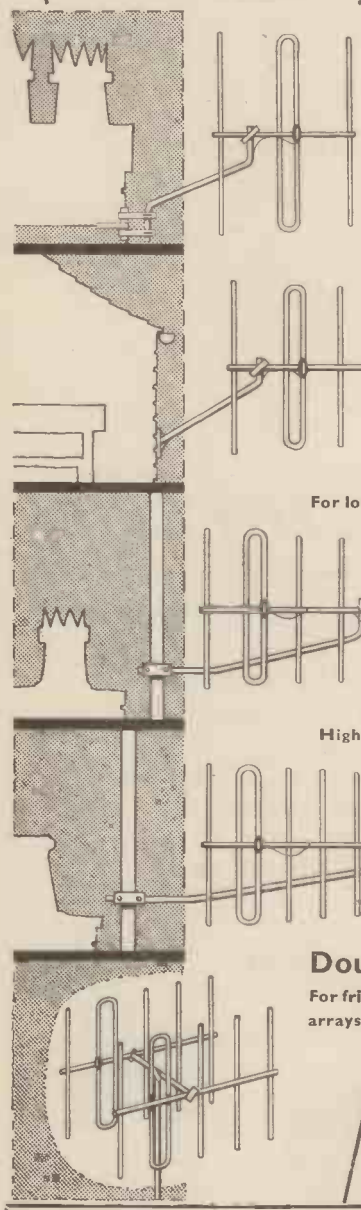

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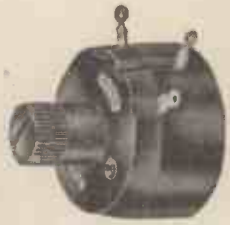

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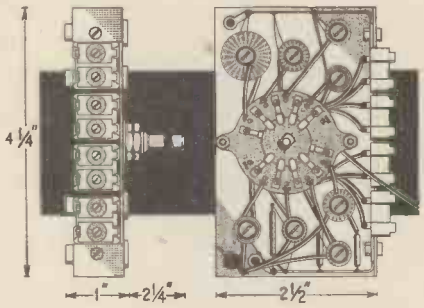

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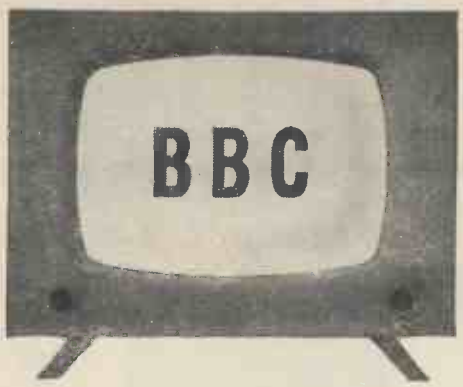

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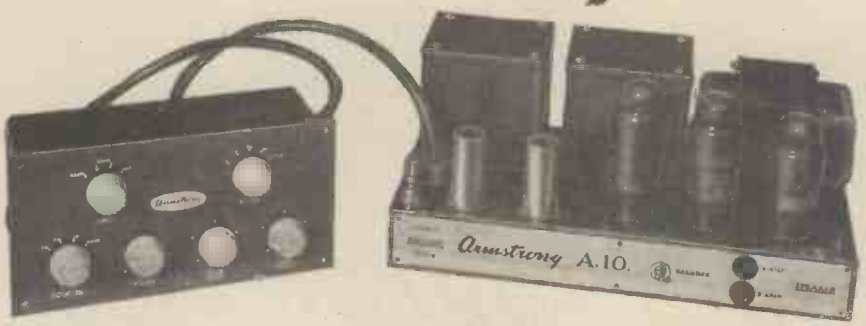

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The Adaphone has an attractive grey plastic case (3in. x 2in. x 1¼in.). Weighted straps hold it in position on any chair arm. The input is matched for 2 to 10 ohms connection and the transformer tested to withstand 2,000 volts D.C. The listener can adjust the volume to his individual need without affecting the loudspeaker volume.
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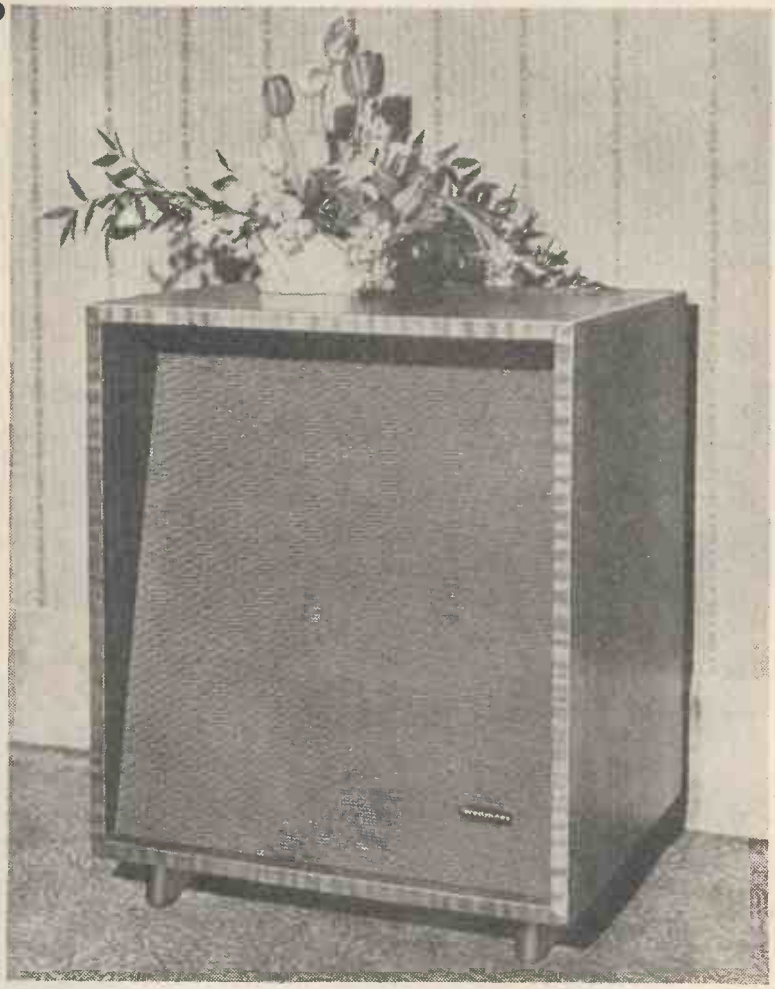
Introducing the *Viscount*

Goodmans' new "VISCOUNT" Loudspeaker enclosure looks well in any setting. Handsomely styled in light mahogany with a contrasting front panel of woven plastic material, this attractive cabinet is built to the AXIOM ENCLOSURE Specification and incorporates Goodmans' famous ACOUSTICAL RESISTANCE UNIT. The "VISCOUNT" can be supplied with or without loudspeaker fitted. *Height: 28 in., width: 24 in., depth: 21 in.*

Recommended units for use in this enclosure are the AXIOM 150 Mk. II or the AXIOM 22 Mk. II where a full range system is required. The AUDIOM 60 or the AUDIOM 70 may also be used in this cabinet as bass units in multi-channel High Fidelity systems.



AXIOM 150 Mk. II
12 in. 15 watts.
Freq. coverage:
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Impedance: 15 ohms.

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12 in. 20 watts.
Freq. coverage:
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Impedance: 15 ohms.

"VISCOUNT" Enclosure only	£19 : 19 : 0
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Provision is made for mounting TREBAX high frequency pressure unit in the front baffle. The aperture for this purpose is blanked off by a detachable panel, and a similar arrangement is made in the rear wall to facilitate the fitting of a variable attenuator for TREBAX. TREBAX may be fitted to the "VISCOUNT" only with AXIOM 150 Mk. II and AXIOM 22 Mk. II loudspeakers: in each case crossover type XO 5,000 should be used.

See the "Viscount" at the Radio Show NOW! Stand no. 105 ..... Demonstration Room D.7

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Post the coupon for leaflets giving full details of this latest addition to the Goodmans range of High Fidelity components.

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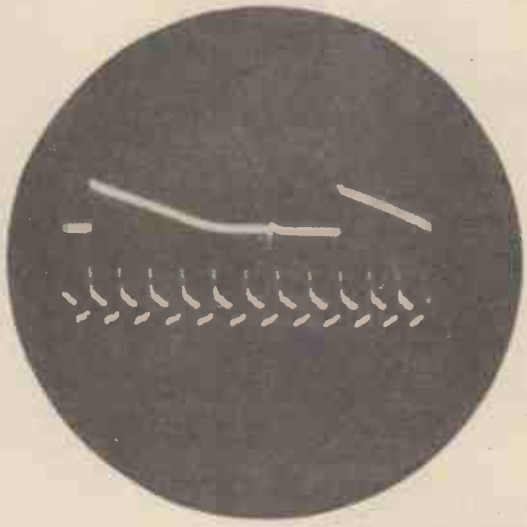

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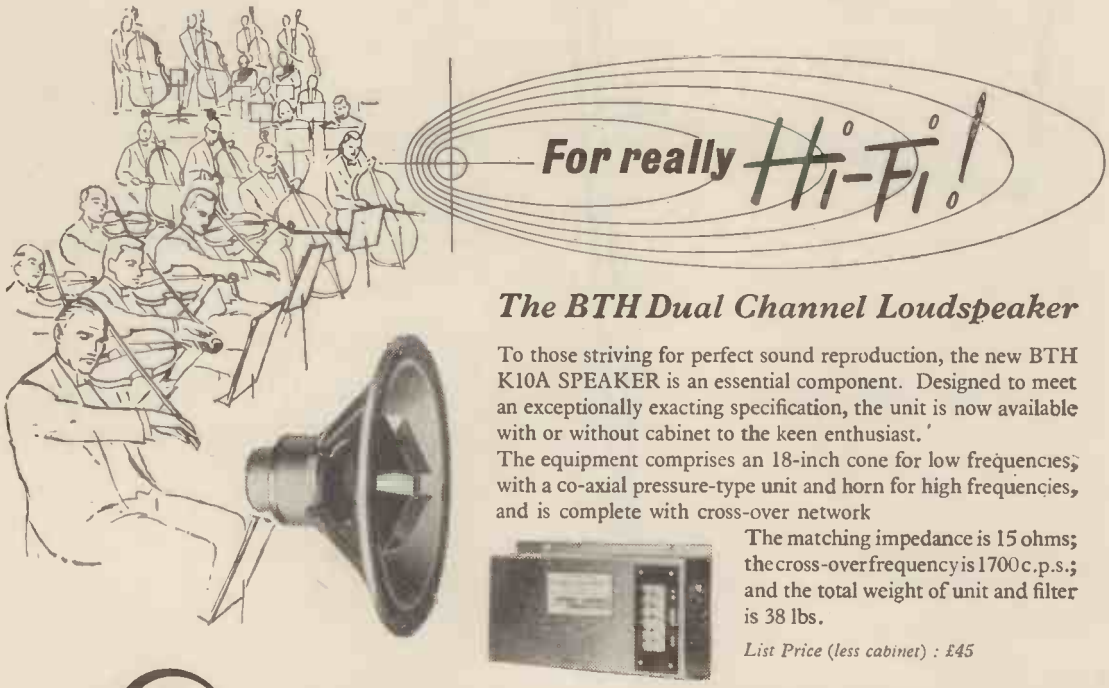

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The equipment comprises an 18-inch cone for low frequencies, with a co-axial pressure-type unit and horn for high frequencies, and is complete with cross-over network

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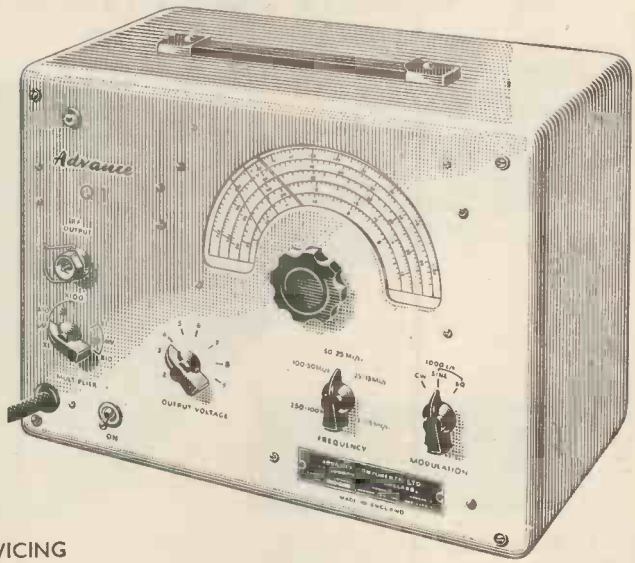

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for TELEVISION (including Band 3) SERVICING

Within this one instrument facilities are provided to deal with Bands 1, 2 and 3 of the five internationally allocated channels for television and V.H.F. broadcasting. The directly calibrated dial with a scale length of 37½in. gives easy reading over the whole range.

Full details in Leaflet W/23

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RELIABLE ATTENUATION

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TO COVER 100 kc/s to 100 Mc/s

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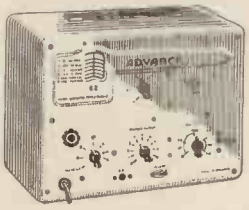

LIST PRICE IN U.K.
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Full details in Leaflet W/14

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An excellent Signal Generator at a most moderate price. The frequency calibration accuracy is ±1% at all frequencies and the RF output level is available from 1μV to 100μV. The RF output may be amplitude modulated 30% at 400 cycles.

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Advance SIGNAL GENERATORS

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The screen is designed for use with the following C.R.Ts. and can be supplied with or without a base clamping bracket.

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Drillings and brackets can be supplied to customers' requirements.

Other standard screens are available for tubes:—

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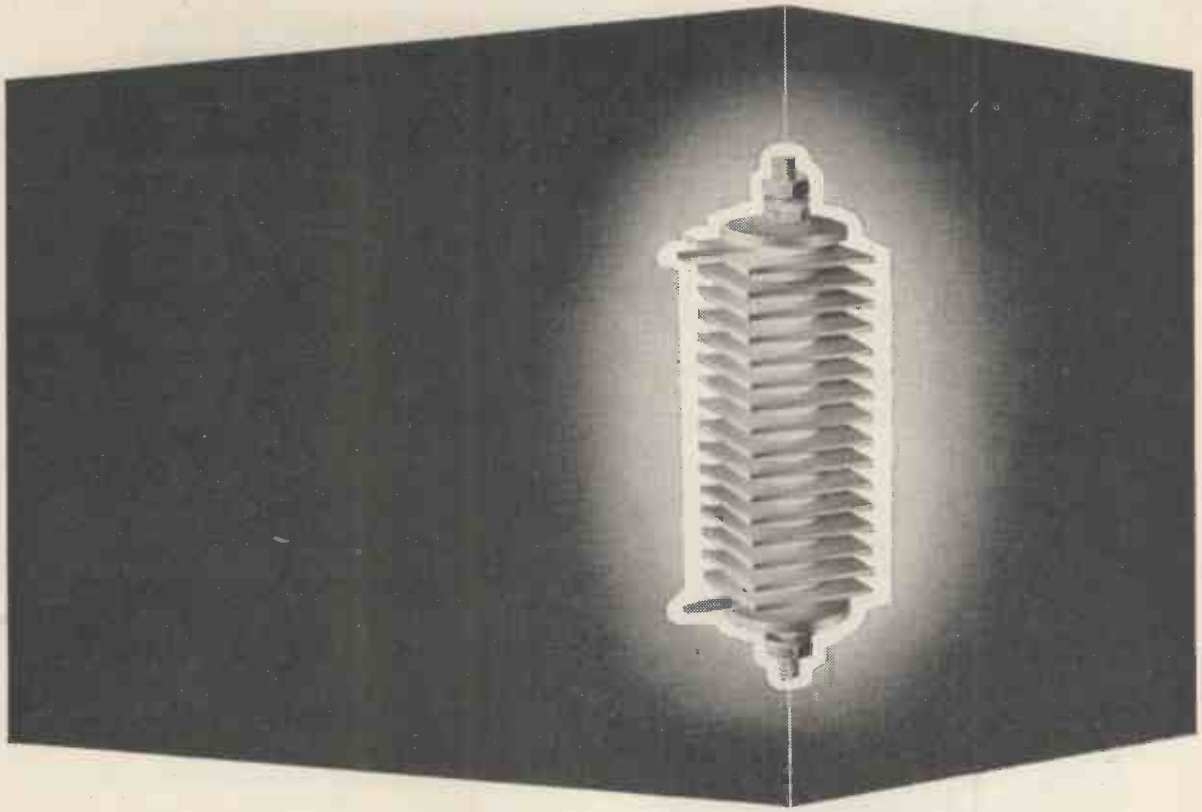

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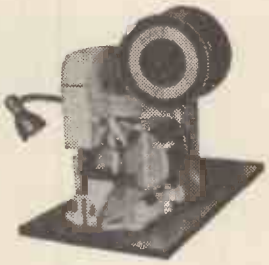

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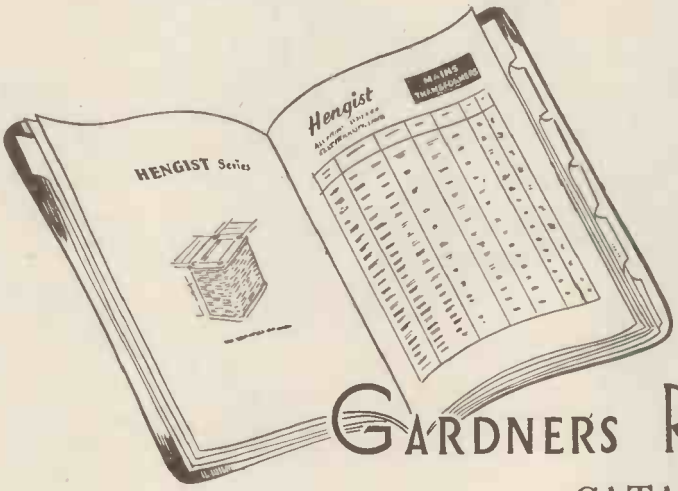

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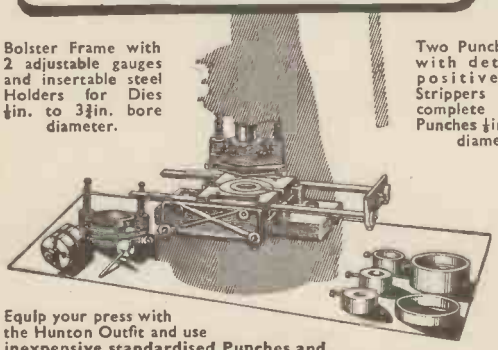

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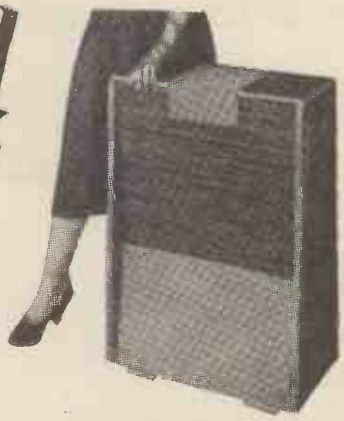

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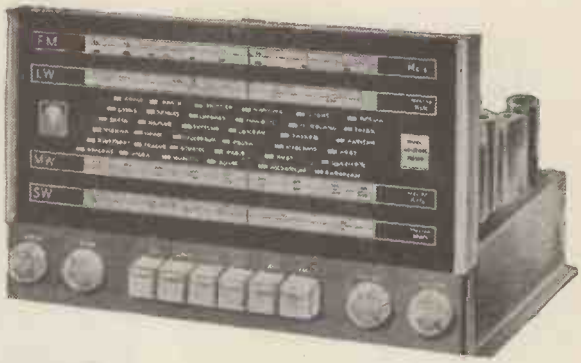

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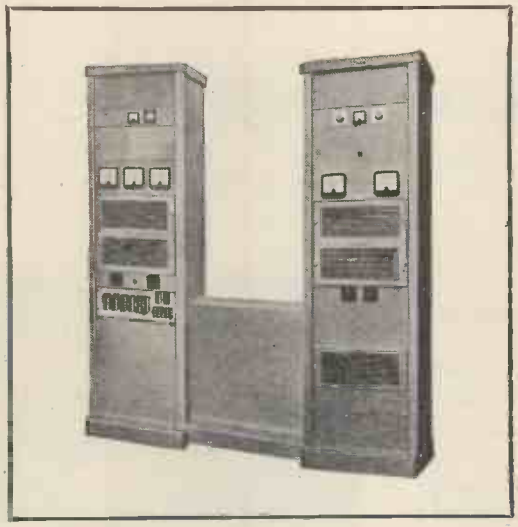

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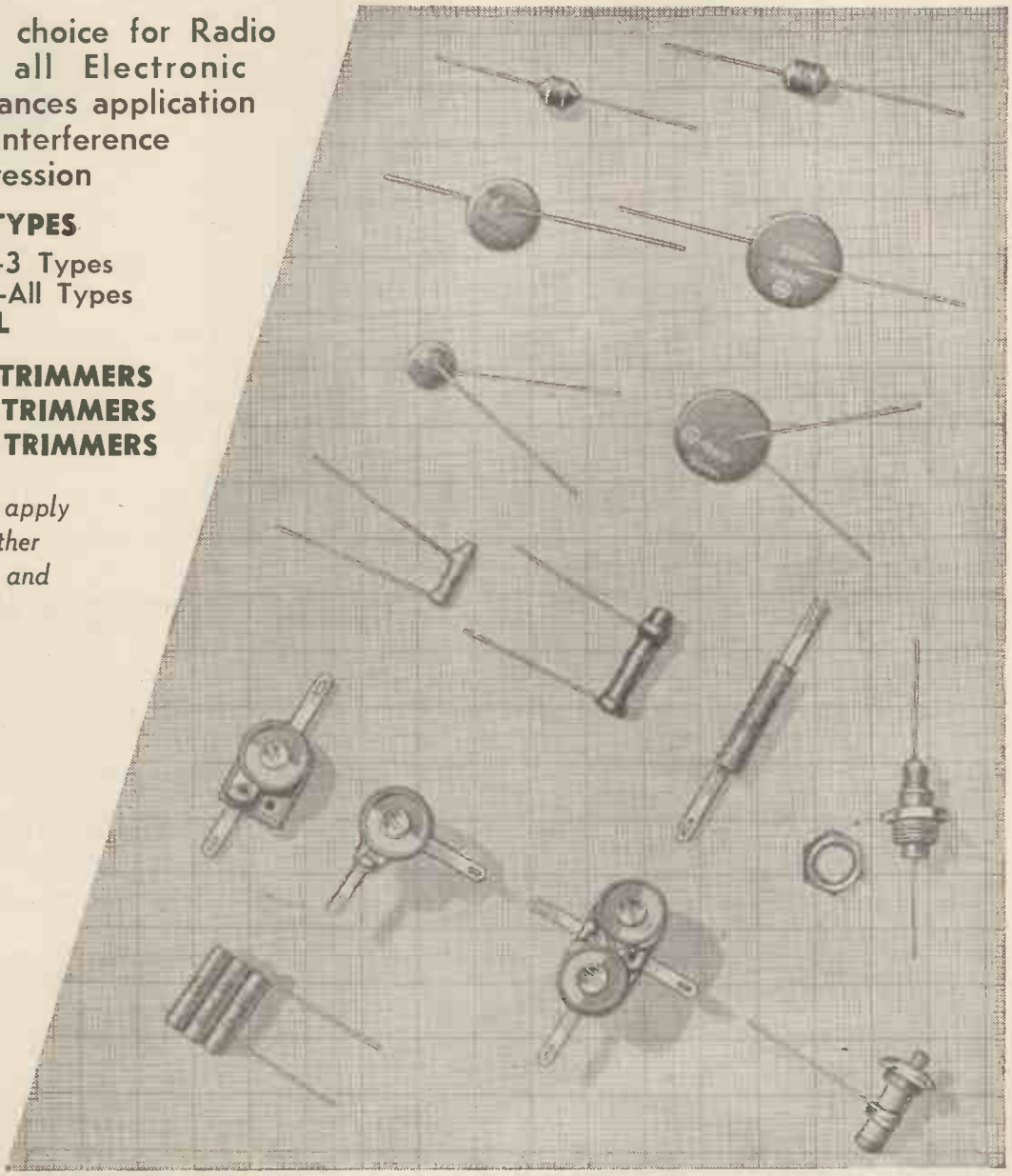

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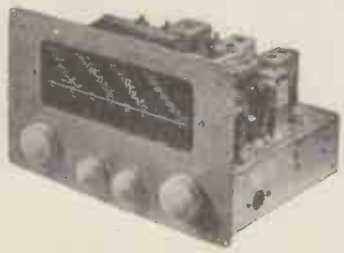

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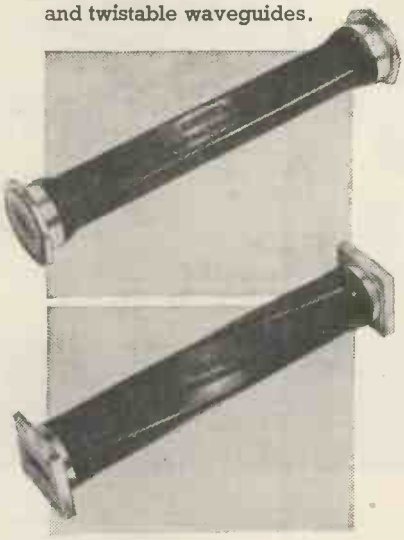

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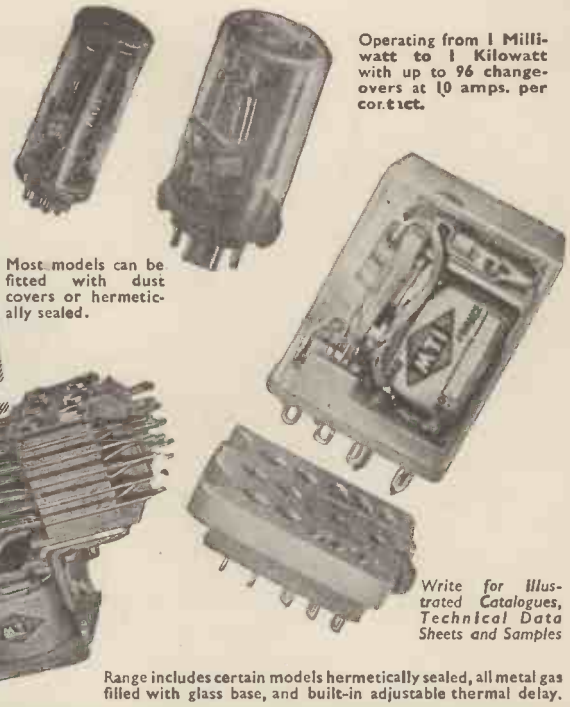

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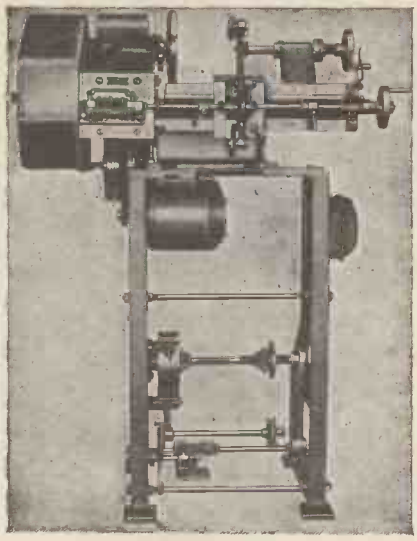

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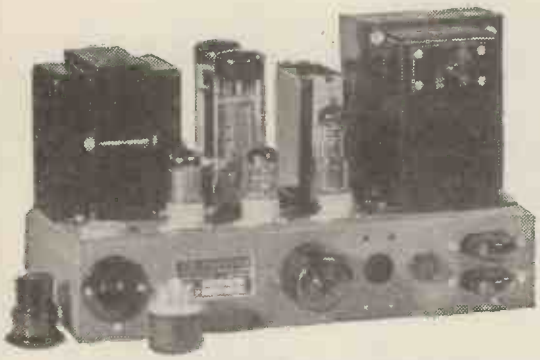

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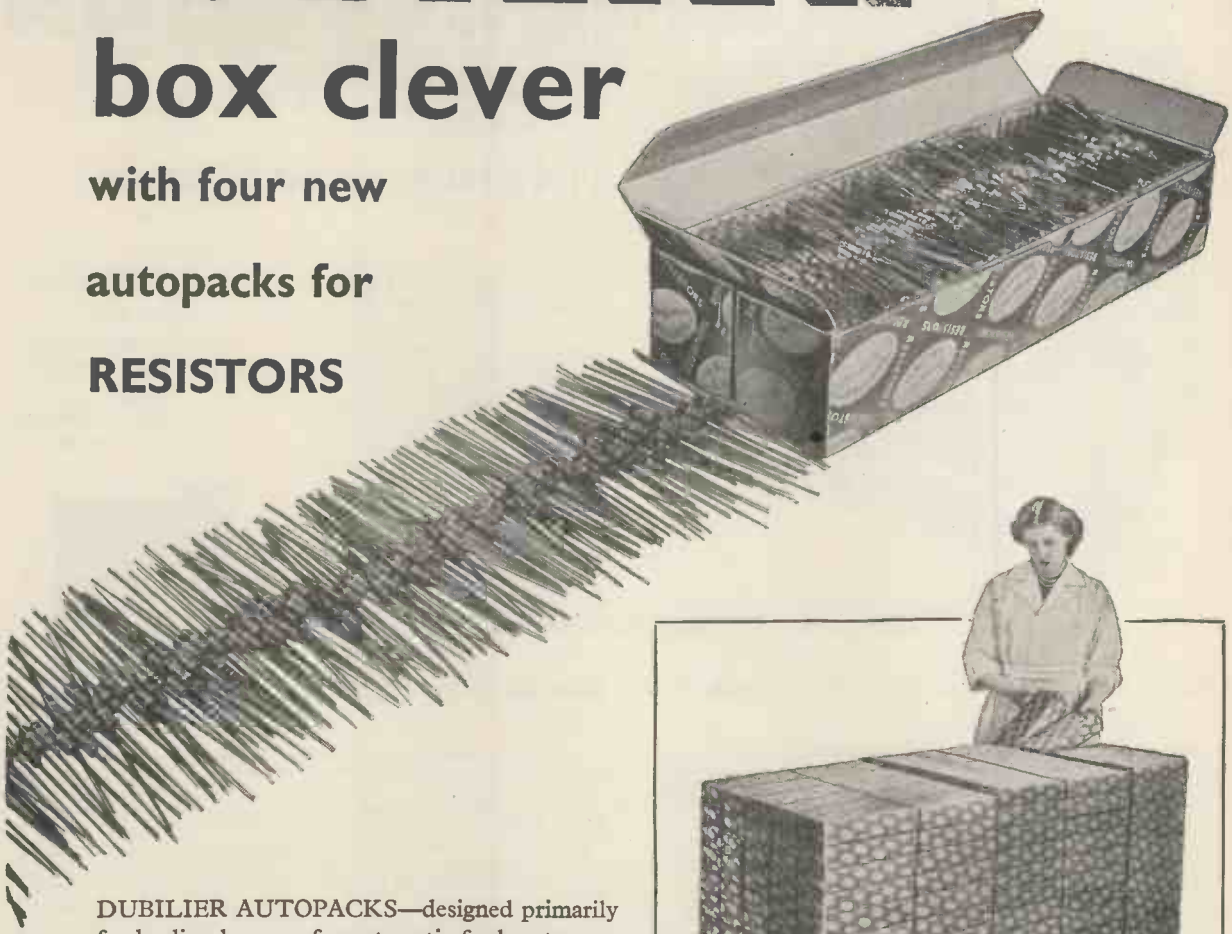

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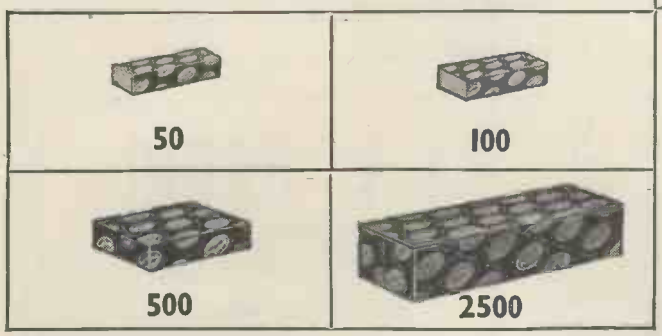

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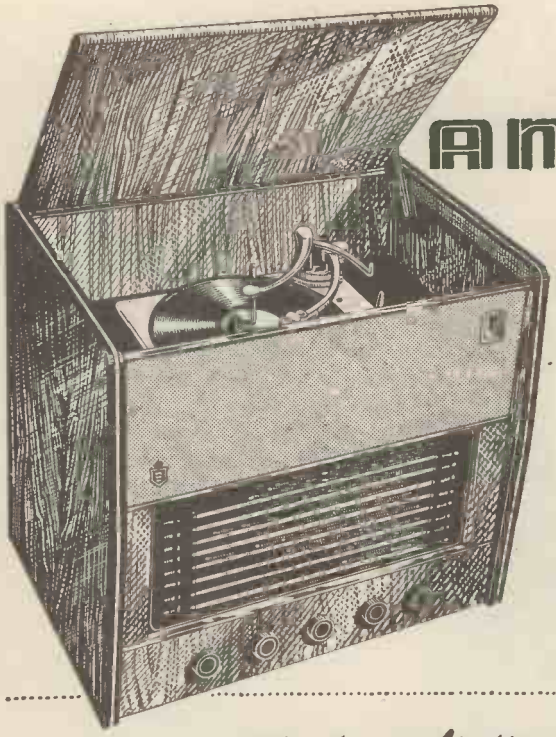

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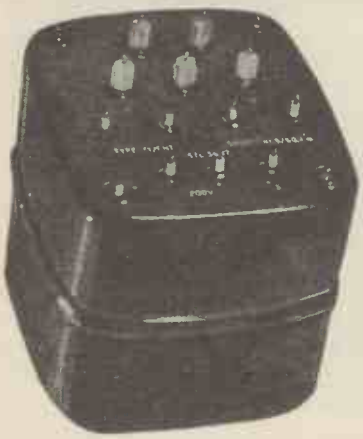

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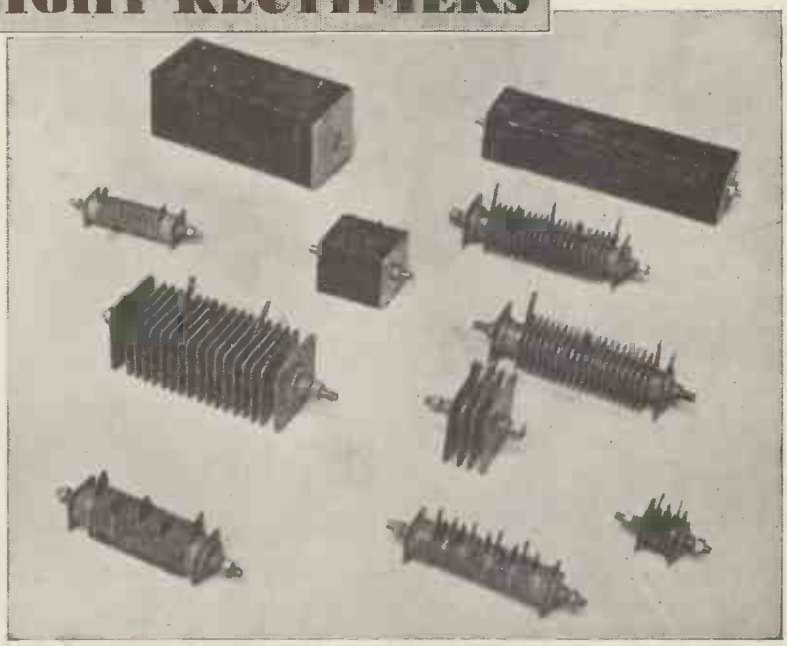

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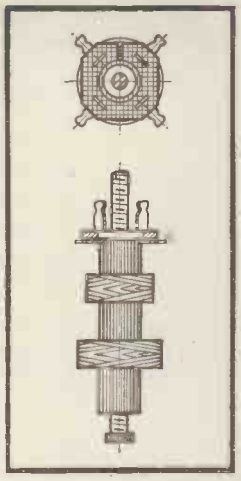

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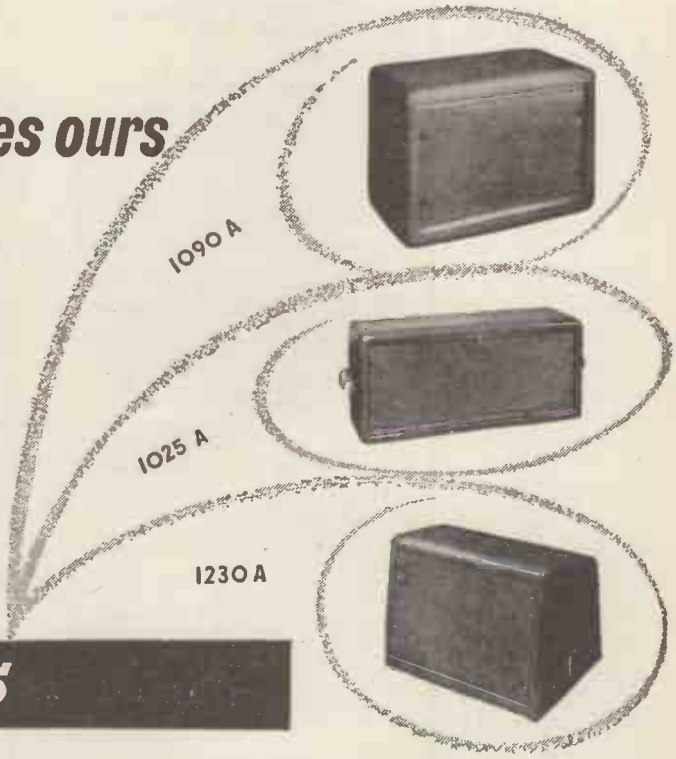

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B.P.L. MEASURING INSTRUMENTS. Shelf-stock again available for immediate delivery: S.50 (5in. rectangular) 25, 50, 100 and 500 Microammeters, and 0/1 Milliamp. Also S.35 (3½in. round) 100 Microammeters and 0/1 Milliammeters. And others—please enquire.

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BRADMATIC

(REGD. TRADE MARK)

Announcing New

BRADMATIC TAPE AMPLIFIERS

PROFESSIONAL RESULTS AT 7½ INCHES PER SECOND

The new type 10 record/play amplifiers have an overall recorded frequency response of 30 to 15,000 cycles within 4 db. at 7½ inches per second with a signal-to-noise ratio of 50 dbs. unweighted.

Two models are available: The type **10/7A** which is designed for normal half-track monaural record and playback whilst the type **10/7AS** is monaural half-track record and stereophonic playback for reproducing stereosonic tapes.

All units are set up to C.C.I.R. characteristics and will reproduce pre-recorded tapes with optimum results.

Both models are constructed on two chassis, the record/play amplifiers on one with the power pack and bias/erase oscillator on the other. No output stages are included, the equipment being designed to feed any normal main or preamplifiers at present available.

The type 10/7A and 10/7AS will also shortly be available built into a Console cabinet complete with a model 5D tape deck.

Further details on application.

BRADMATIC LIMITED for high fidelity, tape desks, magnetic sound heads and accessories.

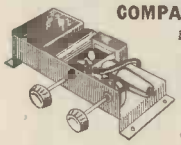
BRADMATIC LIMITED

Station Road, Aston, Birmingham 6

Telephone: East 2881-2. *Telegrams:* Bradmatic, Birmingham.

PREMIER RADIO COMPANY

COMPACT GRAM AMPLIFIER



Suitable for any type of Pick-up. Volume and tone control fitted with knobs Overall size 7¾in. long × 3¾in. wide × 2¾in. high. Complete and ready for use.

£2 . 19 . 6

*Plus packing and postage 2/6

ILLUSTRATED LIST AVAILABLE GIVING FULL DETAILS OF BUREAU TYPE CABINETS

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DARK SCREEN FILTER IN TRIPLEX GLASS 18in. × 14in. SUITABLE FOR ALL TUBES UP TO 17in., 10/-. PLUS PACKING AND POSTAGE 3/-. LATEST TYPE RUBBER ESCUTCHEON SUITABLE FOR 17in. RECTANGULAR TUBES AT A SPECIAL PRICE OF 10/-. PLUS PACKING AND POST 1/6.

We carry a comprehensive stock of components by all leading manufacturers.

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Send for leaflet

6-Valve 3 wavebands 13-50, 190-570 and 900-2,000 metres, in black case with crackle front, illuminated calibrated dial, flywheel tuning, size 17½ × 10 × 8in. Cash £7/10/-, *plus packing and carriage* 10/6. Supplied complete with built-in A.C. Power Supply. **Brand new and ready for use.** Cash £9/19/6, or H.P. terms. *Plus packing and carriage* 10/6. Circuit diagram available, 9d. post free.

A RANGE OF BAND 3 AND F.M. AERIALS IS NOW AVAILABLE

Air spaced co-axial wire, 1/9 per yard.

Teletron Ferrite Rod Aerials. Medium Wave 8/9. Medium Long Wave 12/9.

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Designed to meet the demand for an efficient variable ratio Output Transformer, 11 ratios from 13 : 1 to 80 : 1, all centre tapped and can be used to match any output valves either single or push-pull Class "A," "AB1," "AB2" or "B" to any low impedance speech coil or combination thereof. Primary Inductance 50 henries 15 watts audio 100 mA., Price 45/-.

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All primaries are tapped for 200-230-250 v. mains 40-10 cycles. All primaries are screened.

SP175B, 175-0-175, 50 mA., 4 v. @ 1 a., 4 v. @ 2-3 a.	15/-
SP350A, 350-0-350, 100 mA., 5 v. @ 2-3 a., 6.3 v. @ 2-3 a.	21/-
SP351A, 350-0-350, 150 mA., 4 v. @ 2-3 a., 4 v. @ 3-6 a., 4 v. @ 1-2 a., 4 v. @ 1-2 a.	30/-
SP352, 350-0-350, 150 mA., 5 v. @ 2-3 a., 6.3 v. @ 2-3 a., 6.3 v. @ 2.3 a.	30/-
SP425A, 425-0-425, 200 mA., 6.3 v. @ 2-3 a., 6.3 v. @ 3-5 a., 5 v. @ 2-5 a.	52/6
250-0-250, 80 mA., 6.3 v. @ 4 a., 5 v. @ 2 a.	19/6
350-0-350, 80 mA., 6.3 v. @ 4 a., 5 v. @ 2 a.	19/6
200-230-250 output 3 v.-30 v. @ 2 a.	17/6

PUSH-PULL OUTPUT TRANSFORMERS. 2×6V6 into 2/3 ohms, 5/6, post free.

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200-250 v. A.C. Will charge 2 v., 6 v. and 12 v. Car Battery at 1 amp. Housed in strong metal casing. Finished in Green hammered enamel. Size 6in. long, 3½in. wide, 3½in. high. Guaranteed 12 mths. The above unit is manufactured by PREMIER and does not contain Ex-Govt. components. Plus 2/6 P. and P. **35/6**

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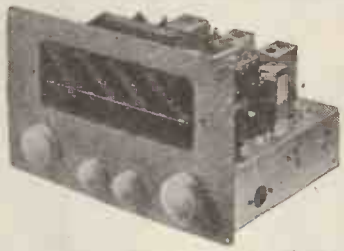
Ferrite rod 6in. × $\frac{5}{16}$in., complete with descriptive constructional details. These aerial rods are suitable for medium and long wave reception. Price 5/3, post free.

THE JASON "ARGONAUT" MW/FM DESIGN

All Premier Components are designer approved



The very latest FM Receiver design PLUS a medium waveband, as described in "The Radio Constructor," ALL components to build the complete Receiver, including output stage, may be purchased for £15/5/-, or all components less output stage but including Power Supply, for £13/19/6, plus packing and postage 3/6 on each. The chassis, front plate, dial, flywheel drive assembly special tuning condenser and wavechange switch (which includes main switch) supplied completely assembled. This is also available separately at £4/4/- plus packing and postage 2/6.

SEND 2½d. STAMP FOR OUR 1956 CATALOGUE

PORTABLE TAPE RECORDER CABINETS

All Rexine covered

Tape Deck	Amplifier	Type	Price
Lane Mk. VI	Premier	Mk. VI	£4/19/6
Lane Mk. VI	Premier	de Luxe	£4/19/6
Truvox Mk. III	Truvox C	T.D.3	£4/4/-

Plus Postage and Packing 5/-.

RECTIFIERS

	E.H.T.	Pencil Type	S.T.C.
Type K3/25	650 v.	1 mA.	4/7
,, K3/40	3.2 kV.	1 mA.	6/-
,, K3/45	3.6 kV.	1 mA.	8/2
,, K3/50	4 kV.	1 mA.	8/8
,, K8/100	8 kV.	3 mA.	14/8
,, N3/160	12 kV.	1 mA.	21/6
,, K3/180	14.4 kV.	1 mA.	24/6
	H.T.	**Type**	**S.T.C.**
Type RM1	125 v.	60 mA.	4/-
,, RM2	125 v.	120 mA.	4/6
,, RM3	125 v.	125 mA.	5/6
,, RM4	250 v.	250 mA.	18/-
	L.T.	**Type**	**Full Wave**
12 v. 1 amp.			8/-
12 v. 2.5 amp.			12/6
12 v. 4 amp.			19/6

T.S.L. ELECTROSTATIC SPEAKERS

Type LSH75	Price 12/6
Type LSH100	Price 21/-
Type LSH518	Price 17/6

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Limited Quantity

The well-known Band 3 Univerter in chassis form suitable for any home-built or commercial Television, will fit into existing Cabinet complete with own A.C. Power Supply, tested and ready for use, two models, London or Midland. Cash price £6/6/-, plus packing and postage 3/6.

LATEST B.S.R. MONARCH 4-SPEED AUTOCHANGER

Designed to play 12in., 10in. and 7in. Records intermixed in any order at 16, 33⅓, 45 or 78 r.p.m. Capacity 10 Records. New reversible Dual Stylus Crystal Pick-up, for use on 100/250 v. 50 cycle A.C. mains. £9/15/-, plus packing and postage 5/-. Deposit 25/- and 8 monthly payments of 25/-.

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By famous manufacturer with crystal turnover head, for use on 100-250 v. 50 cycle A.C. mains. £6/19/6. Plus pkg. & carr. 5/-.

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PLESSEY 8in. dia., Mains Energised, 3 ohms imp. (600 ohms field) with Pentode Transformer	12/6
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MINIATURE TUNING CONDENSERS

2-gang .0005 mfd. with trimmers, 6/9.

ITEM	CASH PRICE	CREDIT TERMS DEPOSIT	CREDIT TERMS MONTHLY PAYMENTS	H.P. TERMS DEPOSIT	H.P. TERMS MONTHLY PAYMENTS
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Premier Bureau Cabinet	16 16 0	2 2 2	(8) 2 1 9	8 8 0	(12) 15 8
Premier Bureau de Luxe Cabinet	17 0 0	2 2 6	(8) 2 2 3	8 10 0	(10) 19 0
Rogers Amplifier and Pre-amp.	26 0 0	3 4 0	(8) 3 4 0	13 1 3	(12) 1 4 0
Mullard EAR/5/10	18 18 0	2 7 3	(8) 2 6 6	9 9 3	(8) 1 6 3
Mullard EAR/6/10P	24 3 0	3 0 6	(8) 2 19 5	12 2 0	(12) 1 2 4
Leak TL10	28 7 0	3 11 0	(8) 3 9 9	14 3 0	(12) 1 6 4
Garrard Transcription Type 301 less P/U.	26 8 3	3 6 0	(8) 3 5 0	13 4 0	(12) 1 4 6
Garrard Transcription Type TA/AC Unit	11 6 7	1 8 7	(8) 1 8 6	5 12 7	(6) 1 2 4
Garrard Transcription Type TA/AC/DC Unit	19 10 5	2 9 2	(8) 2 8 0	9 15 0	(10) 1 1 9
Garrard Changer Type RC80M AC/DC	26 3 5	3 5 5	(8) 2 10 1	13 1 9	(12) 1 4 3
Garrard Changer Type RC98H AC	19 17 7	2 9 1	(8) 2 9 0	9 19 4	(9) 1 4 6
Lenco Transcription Unit Model F50-8 complete with P/U.	21 16 2	2 14 6	(8) 2 13 8	10 18 8	(12) 1 0 2
Goodmans Axiom 102 Speaker	10 7 9	1 5 0	(8) 1 6 6	5 3 9	(6) 1 0 8
Goodmans Axiom 150 MK. 1.	10 15 9	1 7 1	(8) 1 7 4	5 7 9	(6) 1 1 4
Goodmans Axiom 22 MK. 2	15 9 0	1 19 0	(8) 1 1 8	7 14 4	(8) 1 1 10

207 EDGWARE RD., LONDON, W.2. Tel: AMBassador 4033 and PADdington 3271

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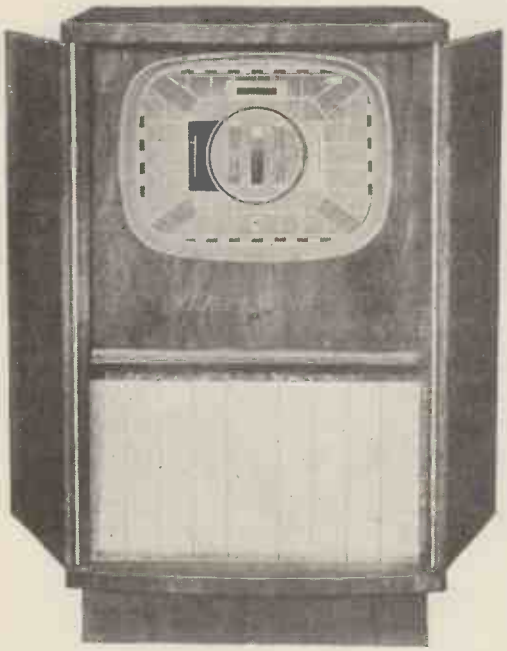
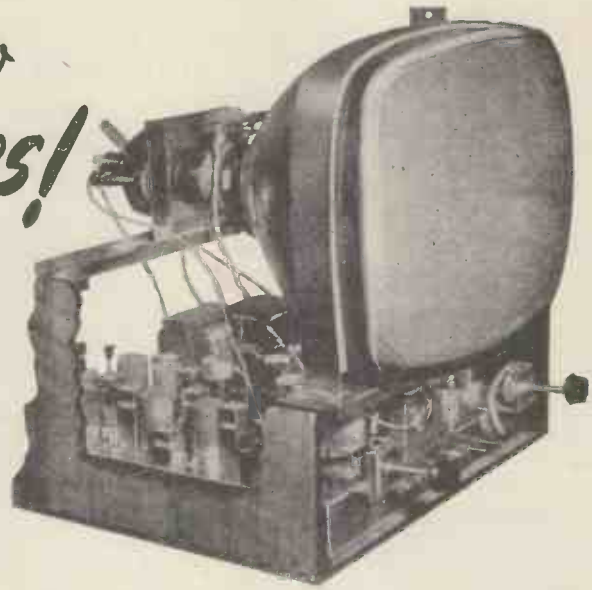
Build these New PREMIER TELEVISORS!





★ **13 CHANNEL DESIGN No. 1**
MAY BE BUILT FOR £32-7-11 PLUS COST OF C.R.T.

★ **5 CHANNEL DESIGN No. 2**
MAY BE BUILT FOR £27-9-4 PLUS COST OF C.R.T.

BUILD IN 5 EASY STAGES. FULL CONSTRUCTIONAL DETAILS AVAILABLE. INSTRUCTION BOOK 3/6 POST FREE INCLUDES BOTH DESIGNS.

CONSOLE CABINETS with full length doors for 14in., 16in. and 17in. tubes PRICE £14/14/–. H.P. Terms: Deposit £7/7/6 and 9 monthly payments of 18/6.

CONSOLE CABINETS, Half door, previously advertised, still available at £12/12/–. H.P. Terms: Deposit £6/6/– and 8 monthly payments of 18/3.

On above cabinets add 21/– for pkg. & carr.

The NEW "PREMIER" TAPE RECORDER

★ Case finished in Brown and Antique Fawn. Size 15in. × 12½in. × 7¾in., with the very latest type continental gilt fittings. For A.C. mains 200–250 volts, 50 cycles.

- ★ Two speeds 7½ and 3¾in. per sec., playing time of 1 hour and 2 hours.
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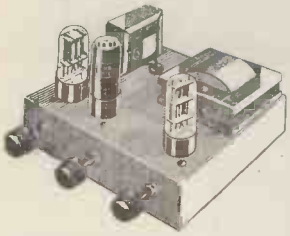
- ★ Positive brakes, no tape "spilling" after braking.
- ★ Fast rewind forward or reverse without removing tape.
- ★ One knob deck operation.
- ★ Amplifier may be used for gramophone or microphone purposes giving high-quality reproduction.
- ★ Superb reproduction of pre-recorded tapes.
- ★ Microphone compartment.
- ★ Complete with reel of Scotch Boy Tape (1,200ft.), spare reel and
- ★ Acos type 33-1 microphone.
- ★ Latest type Lane Mark 6 Tape Deck.
- ★ Dual input channels providing mixing facilities.
- ★ Detachable lid and control cover.
- ★ Control panel finished in matching colours with the tape deck.
- ★ Elliptical speaker of the latest type 7in. × 4in.
- ★ Magic eye recording level indicator.

£5 DEPOSIT & 8 MONTHLY PAYMENTS OF £4.18.6 or CASH PRICE £40 plus 21/- pkg. & carr.

PREMIER RADIO COMPANY,

with PREMIER



4 WATT AMPLIFIER

MAY BE BUILT FOR **£4 . 10 . 0** Plus 2/6 Pkg. & Postage

A steel case is now available, complete with engraved panel, for 15/6 extra. The amplifier may be supplied complete for £5/5/- plus pkg. and post 3/6, or fitted in case at £6/-/- plus pkg. and post 3/6. Engraved panel 3/6. Post Free.

3 BAND SUPERHET RECEIVER

MAY BE BUILT FOR **£7.19.6** Plus 3/- Pkg. & Postage

2-BAND TRF RECEIVER MAY BE BUILT FOR £5.15.0 *plus pkg. & post 3/-*

These two receivers use the latest type circuitry and are fitted into attractive cabinets 12in. × 6½in. × 5½in. in either walnut or ivory bakelite or wood. Individual instruction books 1/- each, post free.

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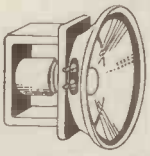
Type LP 312-2

Consists of a 12in. Unit and two LHP65 Treble Units, Co-axially placed to give the widest listening angle. Bass and treble Units have magnetic systems of the highest efficiency, each magnet having a flux density of 17,000 gauss. This Speaker system gives a level response from 20 to 20,000 cycles.

Leaflet available giving full details. Price £14/19/6. H.P. Terms available. Postage and packing 7/6 extra.

Cross-over Unit designed for the LP 312-2 £2/2/0 plus p. & p. 1/6. Single Treble Units available separately at 39/6 each plus packing and postage 1/- extra. Improve your existing Speaker system with this Unit giving an output of 2 k/c to 20 k/c ± 1 db.



A range of High Fidelity Amplifiers, Speakers and Record Players, the following makes in stock:—Leak, E.A.R., Rogers, Goodmans, Wharfedale, W.B. Stentorian, Lorenz, B.S.R., Collaro, Garrard, Lenco Connoisseur.

We shall be only too pleased to demonstrate any of the above equipment.

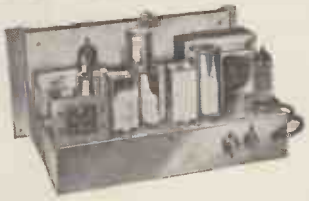
Why not make the best!

MULLARD AMPLIFIER KIT

All the components for model 510, PLUS pre-amplifier on one chassis (total six valves) chassis gold hammer finished. May be purchased for £12/12/- plus pkg. & post 7/6, or pre-amplifier and tone control in a separate unit £14/14/- plus pkg. and post 7/6.

CAN WE HELP YOU!

IF THE EQUIPMENT OR COMPONENTS YOU REQUIRE ARE NOT IN OUR ADVERTISEMENT, DON'T HESITATE TO WRITE TO US—WE PROBABLY HAVE THEM IN STOCK.



THE NEW TSL FM TUNER MARK 2

6 Valves including Magic Eye and Power Supply using the latest type Gorler permeability Unit complete with first audio stage and preset output volume control. Maximum radiation less than 10 microvolts per metre. Sensitivity better than .5 microvolts. Cash price £17/10/- (inclusive) or on H.P. terms, deposit £8/15/- and 9 monthly payments of £1/1/8. Credit terms, deposit £2/3/9 and 8 monthly payments of £2/3/4. Postage and packing 5/- extra.

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Substantially made from Bright Aluminium with four sides:

7 × 5½ × 2in.	4/6	10 × 9 × 3in.	10/-
7 × 3½ × 2in.	3/6	12 × 10 × 3in.	12/-
9½ × 4½ × 2in.	4/9	14 × 10 × 3in.	13/6
10 × 8 × 2½in.	8/-	16 × 10 × 3in.	14/8
12 × 9 × 2½in.	10/-	16 × 8 × 2½in.	11/5
14 × 9 × 2½in.	11/-		

ALUMINIUM PANELS 18 s.w.g.

7 × 6in.	1/3	7 × 4in.	1/-
9½ × 6in.	1/9	9½ × 4in.	1/3
10 × 9in.	2/9	10 × 7in.	2/3
12 × 9in.	3/6	12 × 7in.	2/9
14 × 9in.	4/-	14 × 7in.	3/3
16 × 9in.	4/6	16 × 7in.	3/6
20 × 9in.	5/6	20 × 7in.	4/6
22 × 9in.	6/3	22 × 7in.	5/-

ALL DRY BATTERY PORTABLE RADIO RECEIVER

MAY BE BUILT FOR **£7.8.0** Plus 3/- Pkg. & Postage

4 Miniature valves in a superhet circuit covering medium and long waves, Rexine covered cabinets 11½in. × 10in. × 5¾in., in two contrasting colours, wine with grey panel. Instruction book 1/6 post free, which includes full constructional details and list of priced components.

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Supplied completely wired and tested for £20, or available on H.P. or Credit terms, postage and packing 10/-.

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Available completely constructed, £5/5/-, plus 2/6 packing and postage.

The most efficient BAND III CONVERTER available

Includes 2 valves plus metal rectifier utilising the latest circuit technique. Midland, North and London Models A.C. Mains only 200/240 V., complete with power supply. Provision is made by means of a four position switch to cover all Band III channels. Size—Height 2½in., Width 5½in., Length 8½in.

PRICE COMPLETE **£8 . 8 . 0** *Plus 2/6 pkg. & carr.*

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The latest "Dulci" Model H.4

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SEND FOR DETAILS OF OUR H.P. AND CREDIT TERMS

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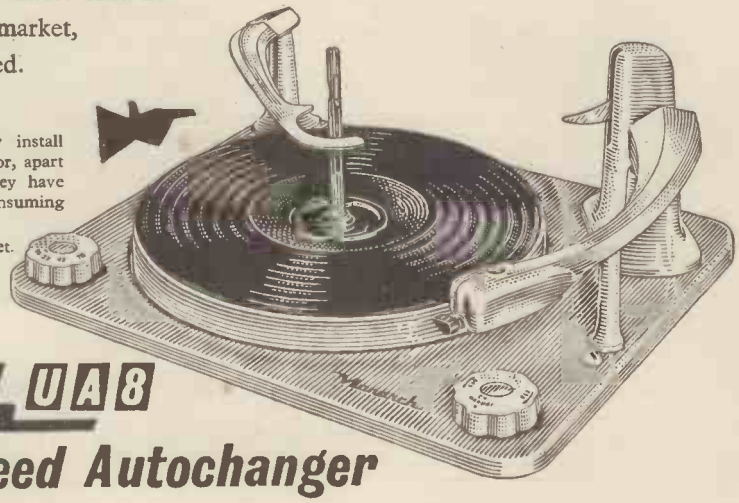
...now Monarch completes the American day!

In many thousand homes throughout the American Continent, the Monarch U.A.8 four-speed automatic record changer is already a firm family favourite. Nightly it demonstrates its versatility and flawless fidelity—faultlessly. And it will go on doing so for many, many years to come!

The Monarch's superb performance and reliability have earned it top honours with leading American set makers. And in this traditionally hard market, honours are truly earned.

★ Many manufacturers now install the Monarch exclusively, for, apart from its fine performance, they have found it free from profit-consuming after-sales problems.
Please write for U.A.8 data sheet.



Monarch UA8
Four Speed Autochanger

BSR

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Wireless World

ELECTRONICS, RADIO, TELEVISION

Managing Editor: HUGH S. POCOCK, M.I.E.E.
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Assistant Editor: F. L. DEVEREUX, B.Sc.

SEPTEMBER 1956

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PRICE: TWO SHILLINGS

FORTY-SIXTH YEAR
OF PUBLICATION

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Transistors for the Experimenter

As in previous years, one of the Mullard contributions to the 1956 Radio Show is a stand supplying technical information to all those who use valves and other electronic devices—whether at work or for their hobby. These enthusiasts are often described generally as home constructors, but many professional engineers, dealers, service engineers, teachers, and students are included among their number. Our publication on transistors this year is called "Transistors for the Experimenter". Deliberately the rather vague term 'experimenter' has been introduced to cover a wide range of interests and requirements. The title does not mean that the booklet has a restricted appeal: on the contrary, nobody need feel left out.

Transistors give us all the opportunity to start afresh and to follow the subject through from its beginnings. A very large part of the booklet has therefore been devoted to the more instructional aspects of transistor applications. More important, many circuits are given in the later pages. Most of the circuits are new, and the text has been completely revised and made several times larger than that given in "Junction Transistors for the Home Constructor". Material which has appeared in earlier advertisements in this series has been included.

Particular interest this year centres round the low power output OC72 junction transistor. Two circuits for a 200mW amplifier are supplied, one for operation from a 6-volt supply and the other for 4.5V. The output and sensitivity are sufficient for small portable equipment such as gramophones and personal radio receivers. A crystal pick-up will drive the amplifier fully. A number of possible r.f. front-ends for the amplifier are described, though the sensitivity requirements of these r.f. circuits are such that in general the amplifier will not be driven to its full output.

Circuits are included which show how the personal receivers can be made in a form which feeds into an insert earpiece. Other new circuits are: a two-transistor R-C coupled sinusoidal oscillator; a symmetrical multivibrator; a bridge balance indicator; and a sensitive e.h.t. voltmeter.

Each circuit is accompanied by notes which show, for example, the possible uses and operating ranges of the equipment. An explanation of the mode of operation of the circuit is given to help the reader grasp the applicational information in the rest of the booklet.

After the circuit descriptions the remainder of the booklet is fairly general. The design of transistor circuits is by no means a hit-or-miss or empirical affair. Although reasonably full design procedure is described to show not only how it's done, but that it can be done, the more immediate and practical methods are not neglected.

Following some introductory notes on the circuit configurations etc., the most important new material comes under the following headings. *Small-signal a.f. stages* shows how small-signal parameters are applied to the earlier stages of amplifiers. *D.C. stabilising* gives a full treatment of this topic, including the preferred system using a potential divider and emitter resistor, and shows how production spreads are allowed for. *Large-signal a.f. stages* is devoted chiefly to Class B and the design of the output stage of the 200mW amplifier, with examples. Further sections indicate the problems encountered at *high frequencies* and in *oscillator* and *switching* circuits etc. *Transistor data* contains a discussion on the choice of limiting values.

"Transistors for the Experimenter" can be obtained at our Radio Show stand or after the show from the address below. No charge is made for this publication.

D 2 A

DEALERS: SERVICE ENGINEERS: HOME CONSTRUCTORS: You are invited to visit the Mullard technical information service in Demonstration Room D2A.

TAPE RECORDER ENTHUSIASTS: Circuits for recording and playback amplifiers are on view. Two circuits are described, with constructional information, in a free booklet "Circuits for Tape Recorders". One circuit is for a unit to feed into a high quality amplifier such as the '5-10'. The other unit is self-contained and gives an output of about 3 watts.

AMPLIFIER CONSTRUCTORS: Built-up amplifier circuits and the f.m. tuner unit are specially displayed. Constructional details of these circuits are given in "High Quality Sound Reproduction" (on sale, price 3s. 6d.). A supplement giving additional information is being issued free. The free leaflet on the 3-valve 3-watt amplifier is being re-issued and shows an improved and slightly modified circuit.

TRANSISTOR STUDENTS: Get your free copy of "Transistors for the Experimenter". Many circuits are described including miniature receivers, pre-amplifiers, and 4.5-volt and 6-volt versions of the 200mW amplifier.

Something for Everybody: Demonstration Room D2A is divided into two parts. General technical enquiries will be answered in an open 'forecourt'. Literature is distributed here, and there is also a display of non-working equipment built from Mullard circuits. Working models of the circuits are located in a demonstration room leading off the forecourt. Constructors can examine and compare the circuits and discuss problems with the engineers.

Mullard

T.S.D. DATA and PUBLICATIONS SECTION, MULLARD LTD., CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2
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Replace the "F/" prefix on the flying lead valve code with one of the following prefixes :—

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Thus an F/6064 in a screened, P.T.F.E. assembly would be specified as SF6064.

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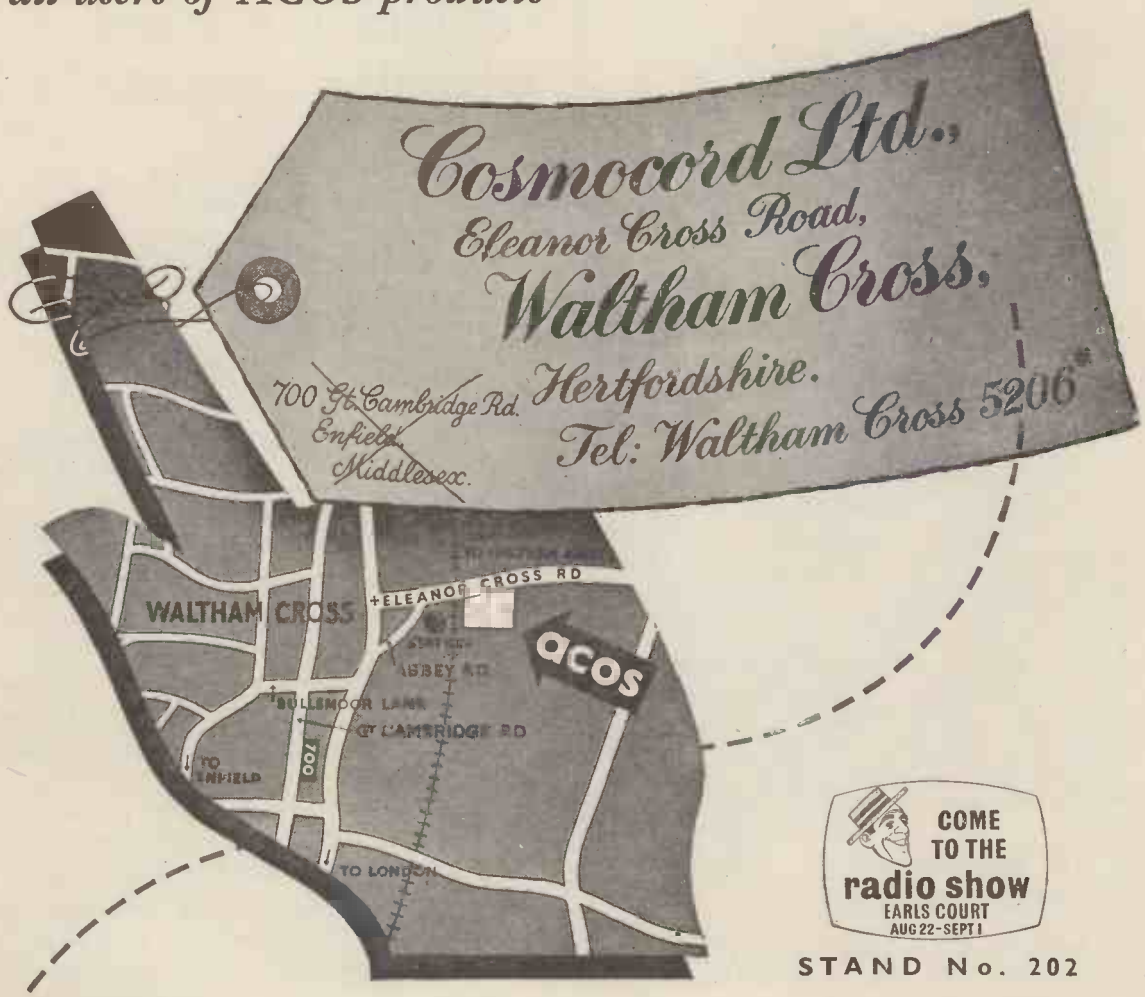

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** Incidentally, customers in the London telephone area who wish to telephone us can do so on the automatic system by dialling WA4 5206.*

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"BELLING-LEE" NOTES

New Collapsable Aerials

We always look upon the Radio Show as our New Year's Day, so with this issue another year commences. May it be a prosperous one for all our readers.

It is not often that we advertise aerials in the *Wireless World* though we talk about them quite a lot. The new range illustrated alongside is quite cunning and should appeal to the practical man. The time taken by the writer to position the crossarm and element correctly ready for fixing to the mast was under 45 seconds, without instruction or previous knowledge. Needless to say electrically they are up to the usual high "Belling-Lee" standard.

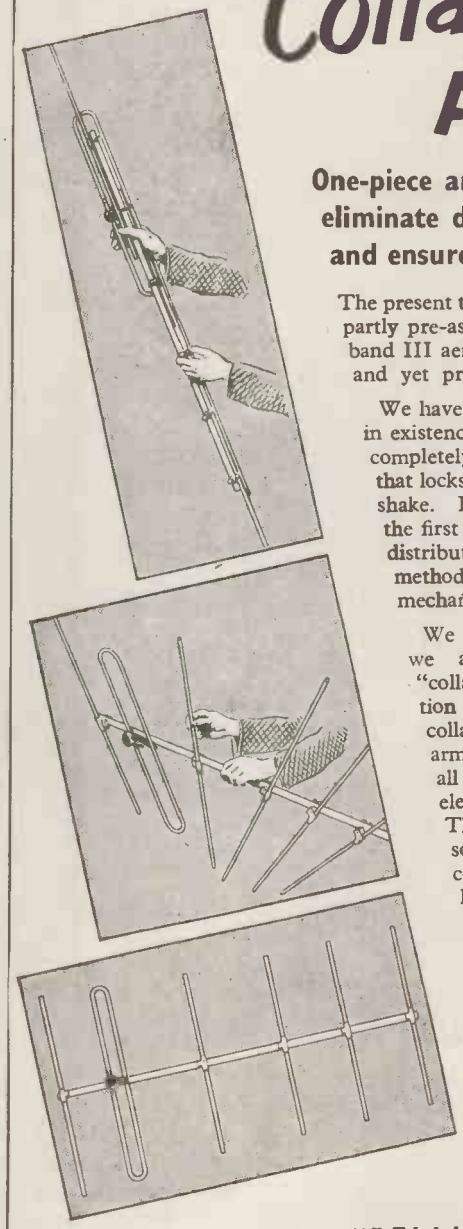
Emley Moor

We had a most successful lecture tour in July in Leeds, Sheffield and Hull. In each place we were able to show a good test card. We were a little surprised how it came through in Hull 70 miles away. Apparently the signal is disappointing in parts of Harrogate but we have hopes that some improvements may result from an alteration to the aerial which will have materialised by the time you are reading this.

We must remind readers, particularly those who may be connected with the Press, that the test transmitter is no longer our property. G9AED is "off the air." It now functions as an I.T.A. transmitter and is manned by the Authority, so enquiries as to schedules, power, etc., should be made to them at Princes Gate. We are still interested in, and anxious to get reception reports so please let us have them and we will send the QSL card illustrated here.

Advertisement of
BELLING & LEE LTD.
Great Cambridge Rd., Enfield, Middx.
Written 18th July, 1956

"BELLING-LEE" Collapsable AERIALS



One-piece arrays cut erection time—eliminate danger of lost parts—and ensure correct assembly!

The present trend being to produce aerial arrays partly pre-assembled, we announce a range of band III aerials designed to cut erection time and yet provide maximum stability in use.

We have avoided the two extremes already in existence both here and in America—the completely pre-assembled array; and the one that locks in position with little more than a shake. Both these have disadvantages: the first take up far too much room in the distributors' stores, while the second method is too expensive if sufficient mechanical strength is to be ensured.

We have taken the middle course, and we are describing our aerials as "collapsable". (The dictionary definition of this word is "capable of being collapsed as for packing".) The crossarm leaves the factory in a carton with all its elements loosely fixed, each element with a dowel and a wingnut. The elements are swung into position so that the dowel engages with its corresponding hole, ensuring perfect location, the wingnut is then tightened and the array is ready to be fixed to the mast, the whole operation taking a fraction of a minute.

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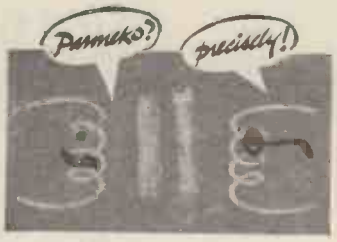

The full range of E type cores is embraced by the new Parmeko three-phase series, from miniature types to those capable of handling up 2.5 KVA at 50 c.p.s. (or greater ratings at higher frequencies). The smaller models are enclosed and hermetically sealed, the larger transformers–impregnated to R.C.S.C. standards–are built into open constructions. For complete details and dimensions write for Parmeko leaflet 456/W/1

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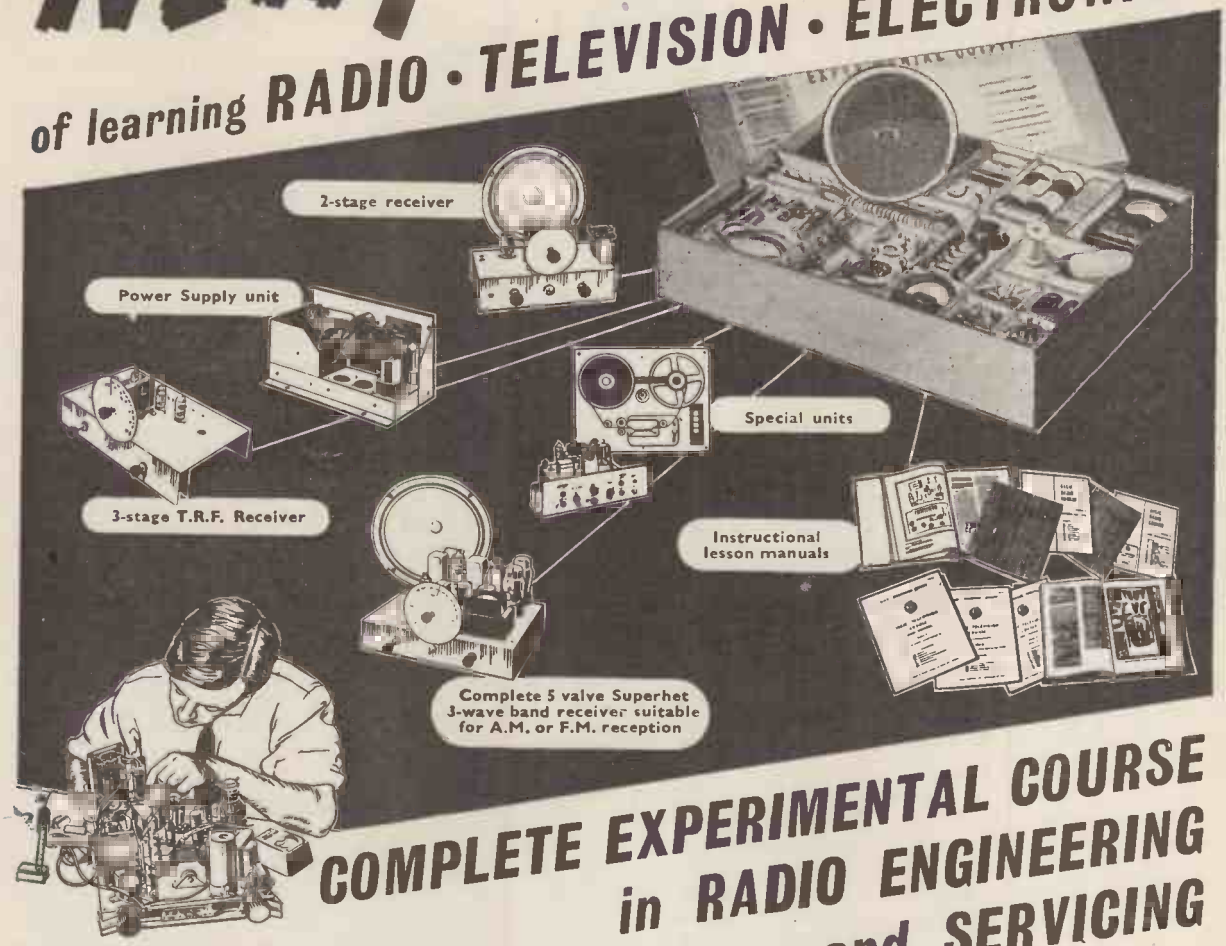

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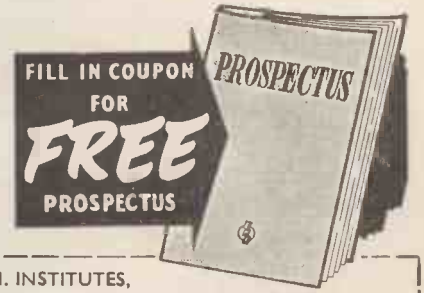
With these outfits, which you receive upon enrolment and which remain your property, you are instructed how to build basic Electronic Circuits (Amplifiers, Oscillators, Power Units, etc.) leading to designing, testing and servicing of complete Radio and Television Receivers.



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SEPTEMBER/56 IC.68A

The latest advance by *Standard* in the field of communication engineering is the balanced pair cable for video transmission, utilizing expanded polythene as an insulant. This dielectric by its greater mechanical rigidity allows a more uniform location of the conductors than previous designs and gives an improved impedance uniformity, while retaining the characteristics of low attenuation and cross talk. These screened circuits are ideal for short television cable links.

Standard VIDEO CABLES

One of the 'Standard' Video Cables is shown being installed at Television House, Headquarters of I.T.A. to connect the studios with the main television switching centre.

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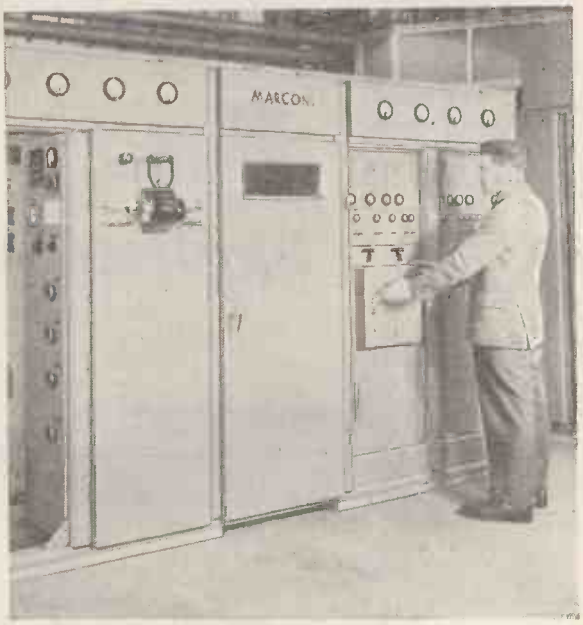
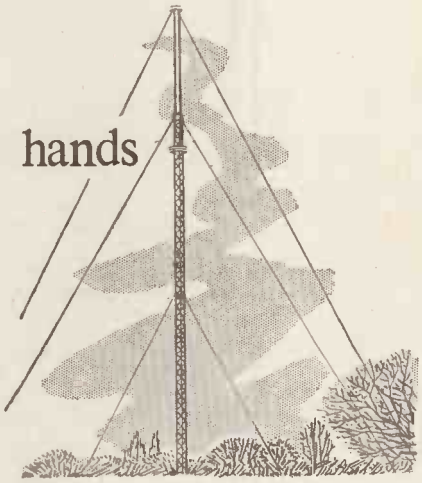
From microphone to aerial



through Marconi's experienced hands



In the surge of new television requirements, Marconi's have not forgotten that the majority of countries still look to them first and foremost for the supply, installation, maintenance and, in some cases, operation of sound broadcasting systems. Moreover, television programmes are not silent; sound broadcasting equipment and techniques must advance in step with vision. The unique experience and advanced technical knowledge of Marconi's are at the disposal of broadcasting authorities all over the world.

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At the very heart of things, electronically speaking, you will find Mullard valves, tubes and other advanced electronic devices. In the sphere of modern aeronautics, Mullard have supplied these products to fit the specific needs of Design Engineers who are concerned in the origination and development of new equipments. And quite frequently, Mullard develop something new both in type and potential purpose, the benefits of which are passed on to Industry at large. Either way the result is PROGRESS.

Down to earth

The life's blood of progress is research. Practical evidence of this belief is to be found in the time and resources Mullard devote to this purpose.

At the S.B.A.C. this year, you will find the Mullard Valve Information Centre at Stand No. 240. This is designed to serve as an informal introduction to the authoritative technical advisory service which is always available for consultation on any application

Mullard

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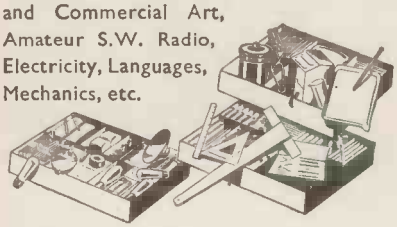

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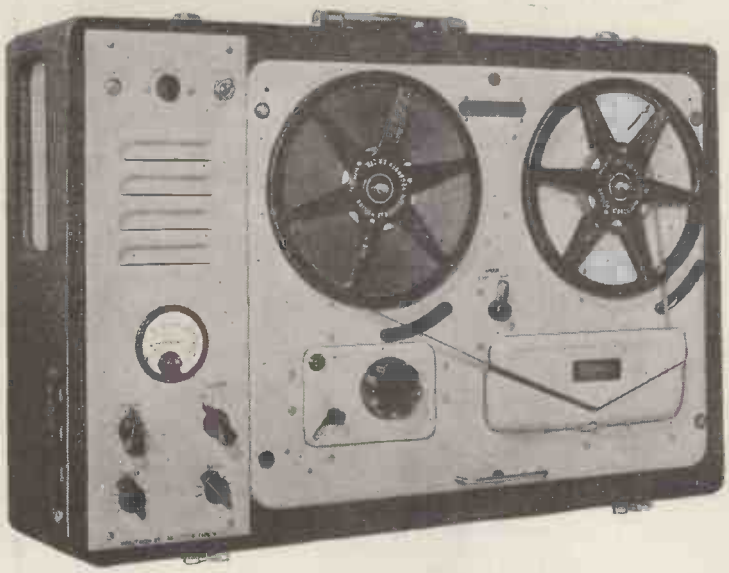
SUBJECT(S) OF INTEREST .....
(We shall not worry you with personal visits) SEPTEMBER IC38a

VORTEXION TAPE RECORDER



★ The total hum and noise at 7½ inches per second 50–12,000 c.p.s. unweighted is better than 50 dbs.

★ The meter fitted for reading signal level will also read bias voltage to enable a level response to be obtained under all circumstances. A control is provided for bias adjustment to compensate low mains or ageing valves.

★ A lower bias lifts the treble response and increases distortion. A high bias attenuates the treble and reduces distortion. The normal setting is inscribed for each instrument.

★ The distortion of the recording amplifier under recording conditions is too low to be accurately measured and is negligible.

★ A heavy mu-metal shielded microphone transformer is built in for 15–30 ohms balanced and screened line, and requires only 7 micro-volts approximately to fully load. This is equivalent to 20ft. from a ribbon microphone and the cable may be extended 440 yds. without appreciable loss.

★ The .5 megohm input is fully loaded by 18 millivolts and is suitable for crystal P.U.s, microphone or radio inputs.

The amplifier, speaker and case, with detachable lid, measures 8¼in. x 22½in. x 15¾in. and weighs 30lb.

PRICE, complete with WEARITE TAPE DECK £84 0 0

★ A power plug is provided for a radio feeder unit, etc. Variable bass and treble controls are fitted for control of the play back signal.

★ The power output is 3.5 watts heavily damped by negative feedback and an oval internal speaker is built in for monitoring purposes.

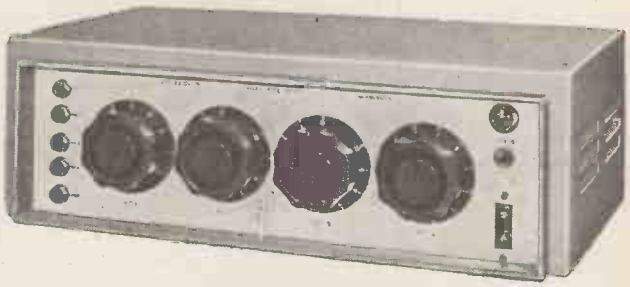
★ The play back amplifier may be used as a microphone or gramophone amplifier separately or whilst recording is being made.

★ The unit may be left running on record or play back, even with 1,750ft. reels, with the lid closed.

POWER SUPPLY UNIT to work from 12 volt Battery with an output of 230 volts, 120 watts, 50 cycles, within 1%. Suppressed for use with Tape Recorder. **PRICE £18.**

FOUR CHANNEL ELECTRONIC MIXER

is almost essential for the professional or semi-professional where a number of different items have to be mixed on one tape recording.
It is recommended by a number of tape recorder manufacturers for this purpose.
Any normal input impedance can be supplied to order, balanced or unbalanced, the standard being 15–30 ohms balanced.
The normal output is 0.5 volt on 20,000 ohms or less, but 600 ohms is available as an alternative.
The steel stove enamelled case is polished and fitted with an engraved white panel suitable for making temporary pencil notes.
An internal screened power pack and selenium rectifier feed the five low noise non-microphonic valves.



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Used in many hundreds of large public address installations, recording studios and Broadcasting Stations throughout the world.

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The Grundig 'Specialist' TK.820/3-D is the best value for your money. Its presentation, its versatility, its performance, its push-button track changeover, makes it the only possible choice for so many people. Provided the machine has the facilities, appearance and ease of control you demand, it remains to check whether or not its specification will stand up to your requirements.

Here is the complete technical specification of the TK.820/3-D. Read it critically—and write to us if there is anything else you would like to know.

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(Electronics Division, Gas Purification & Chemical Co. Ltd.)

GRUNDIG 'SPECIALIST'

Mains voltage: suitable for A.C. only, 105 – 115, 190 – 210, 210 – 230, 230 – 250 volts, 50 cycles. Power Consumption: approximately 90 watts maximum. Mains Fuses: 2 amps (for 105 – 115 volts), 1 amp (for 190 – 250 volts). H.T. fuses: 500 m/A Surge Resisting, 120 m/A Surge Resisting. Valve line-up: EF 86, ECC 81, EL 84, EL 42, EM 71 + 2 metal rectifiers. Mains tapping panel and fuses instantaneously available. Two tape speeds —3¾ ins/sec and 7½ ins/sec: speed change instantaneous by electrical means—heavy duty dual speed split phase induction motor: recording time (with 1,200 feet recording tape) 2 × 30 minutes at 7½ ins/sec – 2 × 60 minutes at 3¾ ins/sec: half track recording, track change without spool reversal: track changeover by press button approximately 2 seconds. Trackbutton remains down to indicate which track was played last: frequency range 50 – 9,000 cycles at 3¾ ins/sec, 40 – 14,000 at 7½ ins/sec: noise is down at least 40 dBs and wow and flutter less than 0.3% at 7½ ins/sec, less than 0.5% at 3¾ ins/sec.

Automatic stop foil at end of spools: fast forward and fast rewind time approximately two minutes per full spool. Illuminated precision place indicator: recording level meter by 'magic eye', tone control for treble or bass emphasis.

Loudspeakers: elliptical high-flux permanent magnet moving coil + two 2½ inch tweeters. Special four-position speaker control. Connections for low impedance extension speaker and high impedance external amplifier remote controls, earphones. Microphone, diode and radio input sockets.

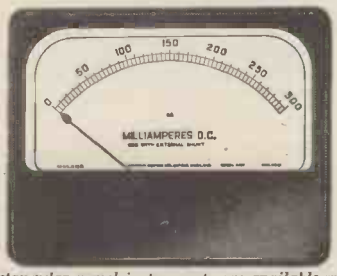
Overall dimensions: 17 inches × 17½ inches × 9½ inches. Weight approximately 48 lb.

Retail Price **98 gns.**

GD273

WESTON panel instruments

Both round and rectangular models of moving iron, moving coil, A.C. rectifier and H.F. thermocouple types are offered. In the range of rectangular instruments, which have been introduced to give the advantage of long, easily-read scales and to harmonize with rectangular panels, certain models are available with illuminated dials. Full particulars of types and ranges available are to be found in leaflets Lists Nos. W.1 and W.2, copies of which are available on request.



Rectangular panel instruments are available with scale lengths of 2.5in., 3.2in., and 4.2in. These offer the advantage of an increase in scale length of approximately 50% over their equivalent round models, for which they can be used as direct replacements using the same panel fixing holes.

Larger instruments, both round and rectangular and for switch boardor panel mounting, are also available. These have scale lengths of 6in. and 6¼in. respectively.

Round models are housed in cases of 2in., 2½in., and 3½in. diameter and have scale lengths of 1.7in., 2.1in. and 2.8in. respectively.

SANGAMO WESTON LIMITED

Enfield, Middx · Tel: ENField 3434 (6 lines) & 1242 (6 lines) Grams: Sanwest, Enfield

Scottish Factory: Port Glasgow, Renfrewshire. Port Glasgow 41151
Branches: London, CHAncery 4971 . Glasgow, Central 6208 . Manchester, Central 7904 . Newcastle-on-Tyne, Newcastle 26867
Leeds, Leeds 30867 . Liverpool, Central 0230 . Wolverhampton, Wolverhampton 21912 . Nottingham, Nottingham 42403
Bristol, Bristol 21781 . Southampton, Soton 23328 . Brighton, Brighton 28497

OLYMPIC HONOUR FOR BRITAIN

We are proud to announce that our TL/12 amplifiers have been chosen for use at the 1956 Olympic Games to be held in Australia.

It was in 1945 that H. J. Leak revolutionised the performance standards for audio amplifiers by designing the original "Point One" series, and we became *the first firm in the world to market amplifiers having a total distortion content of 0.1 per cent.* This claim was received with incredulity, but it was subsequently confirmed by the National Physical Laboratory and since then hundreds of TL/12 amplifiers have been used by the B.B.C., and Commonwealth and foreign broadcasting authorities, and thousands have been used by recording studios, leading musicians and music-lovers throughout the world. We were the only British exhibitor at the world's first Audio Fair which was held in New York in 1949 and the volume of our exports to the United States of America has grown steadily since then.

Further development work resulted in our producing, at a much lower price but with the same high performance standards, the TL/10 amplifier. The TL/10 amplifier and "Point One" pre-amplifier received such an excellent reception when they were first exhibited at the Audio Fair in New York in October, 1953, that we received an initial order for 1,000 sets. Since then several thousand sets have been sold throughout the world. The output of the TL/10 is ample for high-fidelity home music systems, and the quality of reproduction obtained is equal in every respect to that of the TL/12. We always use the TL/10 amplifier and "Point One" pre-amplifier for our public demonstrations of high-fidelity reproduction of gramophone records and radio. The TL/10 amplifier, when used with the best available complementary equipment, gives to the music-lover a quality of reproduction unsurpassed by any equipment at any price. Even when the complementary equipment falls below that of the best obtainable, the use of these amplifiers will enable one to obtain very marked improvements in reproduction.

LEAK

HIGH FIDELITY EQUIPMENT

LEAK TL/10 AMPLIFIER, £17. 17. 0.
& 'POINT ONE' PRE-AMPLIFIER, £10. 10. 0.

Prices made possible only by world-wide sales

POWER AMPLIFIER

Circuitry
A triple loop feedback circuit based on the famous TL/12. The output transformer is the same size as in the TL/12.

Maximum power output: 10 watts.
Frequency Response: ± 1 db 20 c/s to 20,000 c/s.
Harmonic Distortion: 0.1%, 1,000 c/s, 7.5 watts output.
Feedback Magnitude: 26 db, main loop.
Damping Factor: 25.
Hum: —80 db referred to 10 watts.
Loudspeaker Impedances: 16 ohms, 8 ohms, and 4 ohms.

OTHER LEAK PRODUCTS

Varislope II pre-amplifier	£16 16 0	
TL/12 power amplifier	£28 7 0	
TL/25A power amplifier	£34 7 0	
Leak dynamic pickup:—		
Arm	£2 15 0	p.t. £1 3 1
LP head with diamond stylus	£5 15 0	p.t. £2 8 4
78 head with diamond stylus	£5 15 0	p.t. £2 8 4
Mu-metal cased transformer	£1 15 0	
Trough-Line FM tuner unit with built-in power supply	£25 0 0	p.t. £10 10 0

Those seeking to obtain the highest quality of gramophone and radio reproduction are invited to ask their dealer for a demonstration of Leak products which, with their tradition o excellence, represent the best that can be obtained.

"POINT ONE" PRE-AMPLIFIER

The handsome gold escutcheon plate contributes to the elegant appearance, and blends with all woods.

★ Pickup
The pre-amplifier will operate from any pickup generally available in the world. A continuously variable input attenuator at the rear of the pre-amplifier permits the instantaneous use of crystal, moving-iron and moving-coil pickups.

★ Radio
The radio input sockets at the rear permit the connection of the LEAK V.S. tuner unit. An input attenuator is fitted. H.T. and filament supplies are available from the pre-amplifier.

★ Distortion
Of the order of 0.1%.

★ Hum
Negligible, due to the use of recently developed valves and special techniques.

★ Input selector
Radio, tape. records: any and all records can be accurately equalised.

★ Treble
Continuously variable, + 9 db to — 15 db at 10.000 c/s.

★ Bass
Continuously variable + 12 db to — 13 db at 40 c/s.

★ Volume Control and Switch
The switch controls the power supply to the TL/10 power amplifiers.

★ Tape Recording Jacks
An exclusive feature. Readily accessible jacks are provided on the front panel for instantaneous use with Tape Recorders which have built-in (low level) amplifiers.

ELECTROSTATIC LOUDSPEAKERS

Reprints of "The Gramophone" article (May, 1955) by H. J. Leak, summarising his work and findings on Electrostatic and Dynamic Loudspeakers, are available on request, free of charge.

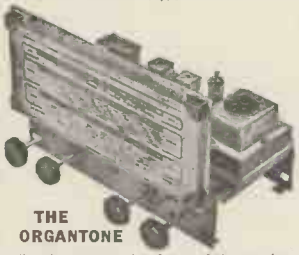
★ *Write for leaflet W* ★

H. J. LEAK & CO. LTD., BRUNEL ROAD, WESTWAY FACTORY ESTATE, ACTON, W.3

Phone: SHEpherd's Bush 1173/4/5 *Telegrams: Sinusoidal, Ealux, London* *Cables: Sinusoidal, London*

THE TWIN 20

This is a complete fluorescent lighting fitting. It has built-in ballast and starter—stove enamelled white and ready to work. It is an ideal unit for the kitchen, over the work-bench and in similar locations. It uses two 20-watt lamps. Price, complete less tubes, 29/6, or with two tubes 39/6. Post and insurance 2/6. Extra 20-watt tubes, 7/6 each.



THE ORGANTONE

5-Valve 3-wave band superhet covering long, medium and short wave.
Osram miniature valves are employed and low loss iron cored coils account for an excellent signal-to-noise ratio. Full A.V.C. is applied to both frequency changer and I.F. stages.
The output stage utilises variable negative feedback. A gram. position is provided and reproduction of records is particularly good.
Chassis size is 12×7×7in.—scale size is 10½×4½in. This receiver has been tested in particularly difficult areas and its stability and noise rejection have produced exceptional results. Price £11/10/- carriage, etc., 7/6.

THE "TREMENDO"

This one is really superb. It has a 7-valve circuit with 6 watts output, fitted with independent bass and treble controls. It is really an efficient R.F. circuit coupled to a high-fidelity amplifier. The chassis size is the same as the Organtone, namely 12×7×7 with the 10½×4½ multi-coloured scale, and it is built to the same exacting specification as the Organtone. Price £15/10/-, carriage and packing 7/6. H.P. terms if required.

BAND III CONVERTER

ADDITA—Many hundreds in use

Any television receiver, whether superhet or straight A.C. or A.C./D.C., home constructed or factory built, which at present will receive B.B.C. will also receive I.T.A., if this converter is added. No modifications at all are necessary to the receiver. Simply plug in aerial leads and connect to A C mains. The converter is in a neat metal case with provision for fixing to the side or the back of the set. Price £6/10/-, or H.P. terms available on request if required.

BUILD YOUR OWN CONVERTER

You can save at least £2 on the above if you build the converter yourself. Price of all components including stove enamelled case is £3/10/- or £4/10/- if mains components also required. Data is included free with the parts or available separately price 2/6.

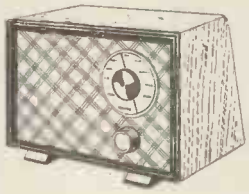
THIS MONTH'S SNIP

The "ESTRONIC" Band III Converter

To-day's best value in Band III converters suitable for your T.V. or money refunded. Complete ready to operate, 49/6 non-mains or 69/6 mains, post and insurance 3/6.

ANNOUNCING THREE NEW SPECIALS

1. THE "SKYSEARCHER"



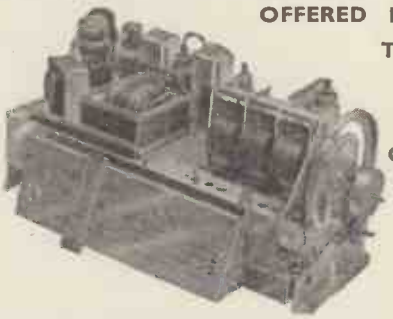
An all mains set for 19/6.
This is a 2-valve plus-metal rectifier set useful as an educational set for beginners, also makes a fine second set for the bedroom, workshop, etc. All parts, less cabinet, chassis and speaker, 19/6. Data free with parts or available separately 1/6.

2. THE "REALITE"

This is a complete metal fitting, stove enamelled white, with starter and ballast all ready to install. Price 25/-, plus 4/6 carriage and packing. 40-watt tube 10/-, no extra for packing, if ordered with fitting.

3. BABY ALARM

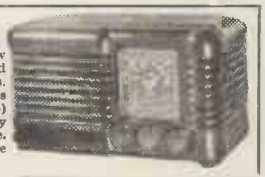
Unlike most baby alarms, this not only enables you to hear baby but also talk to him. Price complete with one microphone and 50ft. twin flex £6/19/6, carriage 3/6. Additional microphone 19/6.



OFFERED FOR LESS THAN THE VALUE OF ITS COIL PACK

This set, a product of one of our famous manufacturers, has H.F. stage, covers 5 wavebands including short waves to 11 metres. Offered less valves, power-pack, scale and drive, otherwise complete and unused. Price £3/15/-, plus 7/6 carriage.

NEW CIRCUIT



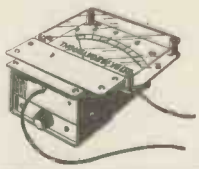
OCCASIONAL 56—we have evolved a new T.R.F. circuit and have had really good results, equal in fact to many superhets. You really should try this circuit. All parts including valves (6K7, 6J7, 6P6, and 6X5) and Bakelite case with back cost only £5/10/-, plus 2/6 post and insurance. Data included with the parts is also available separately, price 2/-.

4-SPEED & 3-SPEED GRAMOPHONE AUTO-CHANGER

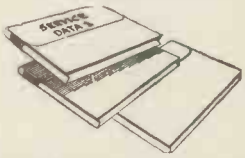
Latest types by all famous makers are invariably in stock at competitive prices. B.S.R., Monarch, Garrard, etc. Latest models from £7/15/-, plus 5/- carriage and insurance.

HIGH VOLTAGE TESTER

An instrument that will measure voltages up to 10,000 but which draws no current from the source, will probably be a valuable addition to your workshop equipment. It can be made entirely from odds and ends. Booklet giving full instructions, plans, etc. 2/6 post free.



SERVICE DATA



100 service sheets, covering British receivers which have been sold in big quantities, and which every service engineer is ultimately bound to meet. The following makes are included: Aerodyne, Alba, Bush, Cossor, Ekco, Ever-Ready, Ferguson, Ferranti, G.E.C., H.M.V., Kolster-Brandes, Lissen, Mc-Michael, Marconi, Mullard, Murphy, Philco, Philips, Pye, Ultra. Undoubtedly a mine of information invaluable to all who earn their living from radio servicing. Price £1 for the complete folder. Our Folder No. 2 consists of 100 data sheets covering most of the popular American T.R.F. and superhet receivers "all dry," etc., which have been imported into this country. Names include Sparton, Emmerson, Admiral, Crossley, R.C.A., Victor, etc. Each sheet gives circuit diagrams and component values, alignmen procedure, etc., etc. Price for the folder of 100 sheets is £1. Post free.

THERMOSTATS

2¾in. × 1in. × 1½in. high.
Useful for the control of appliances such as convectors, gluepots, valcanisers, hot plates, etc. Adjustable to operate over temperature range 50-550 deg. F., fitted with heavy silver contacts.
1½ amp., 3/6; 5 amp., 8/6; 2 amp. QMB, 5/6; 5 amp. QMB, 15/-.

CHASSIS ASSEMBLY

Three-colour 3-waveband scale covering standard, Long, Medium and Short wavebands, scale pan, chassis, punched for standard 5-valve superhet, pulley driving head, springs, etc., to suit. Scale size 14½×3½in. Chassis size 15×5×2in. deep. Price 15/- plus 1/6 post. Note—We can supply cabinet for this, 39/6, and 5/- p. and p.

INDUSTRIAL OVERHEAD HEATER

This overhead heater warms only the area within its radiant rays, and so effects a considerable saving of fuel. Its benefits are felt immediately, there is no warming-up period. It is essentially a personal type of heater, having controls within easy reach of the operative. The controls give four variations of heat and "Off." At maximum heat the unit consumes 1 kW.
The Infray Major is of particular use:—
(a) In large rooms, warehouses, lofts, machine shops, etc., where the cost of heating the whole room to a comfortable level would be too great.
(b) In rooms which in the main have to be kept cool, e.g., food storage chambers, beer cellars, etc.
(c) In any situation where local heating is required quickly.
Price is £7/10/-, carriage paid.

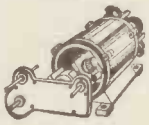
MULTI-METER KIT

Parts suitable for making a multimeter to measure volts, milliamps and ohms. Kit containing all the essential items including moving coil meter, resistors, range selector, calibrated scale, etc., etc., is only 15/-, plus 1/- post and packing.

NEW MULLARD AMPLIFIER "510"

A High Quality Amplifier designed by Mullard engineers. Robust high fidelity with a power output exceeding 10 watts and a harmonic distortion less than .4% at 10 watts. Its frequency response is extremely wide and level being almost flat from 10 to 20,000 C.P.S.—three controls are provided and the whole unit is very suitable for use with the Collaro Studio and most other good pick-ups. The price of the unit completely made up and ready to work is £12/10/-, plus 10/- carriage and insurance. Alternatively, if you wish to make up the unit yourself we shall be glad to supply the components separately. Send for the Mullard amplifier shopping list.

MULTI-SPEED MOTOR

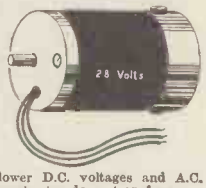


Works off A.C./D.C. mains, fitted with gear box gives any speed from 1 r.p.m., 22/6, post and packing 1/6.

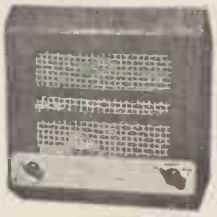
SENSITIVE ALTIMETER

(Very good but not perfect). These contain aneroid barometer movement. Price only 5/-, post, etc., 1/6.

MINIATURE MOTOR



Size only 2½in. long by 1½in. diameter American made — laminated poles and armature — intended for 28 - volt D.C. but O.K. on lower D.C. voltages and A.C. mains, through step-down transformer—price 10/6, post, etc., 2/-.



OFFICE INTERCOM

This is a 2-station master unit, comprising an A.C. mains push pull amplifier with built-in P.M. speaker—in polished cabinet with volume control and on/off switch—all ready to work—price £6/19/6, with one sub-station—extra sub-stations 19/6 each—carriage and packing 3/6.

THE "CRISPIAN" BATTERY PORTABLE

A 4-valve truly portable battery set with very many good features as follows:—Ferrite rod aerials.

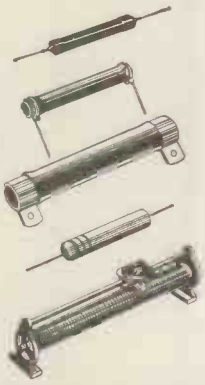
- **Low consumption valves (OK96 range).**
- **Superhet circuit with A.V.C.**
- **Ready built and aligned chassis if required.**
- **Beautiful two-tone cabinet.**
- **Guaranteed results on long and medium waves anywhere.**

All parts, including speaker and cabinet, are available separately or if all ordered together the price is £7/15/- complete. Post and insurance 3/6. Ready built chassis 30/- extra. Instruction booklet free with parts or available separately 1/6.

VALVE LIST

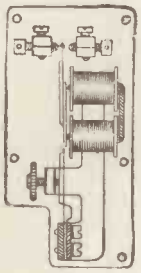
AZ31	8/6	U74	8/6	6J7	6/6
CV1199	5/6	VP23	7/-	6K6	6/6
DAF91	9/-	VR55	7/6	6K7	6/9
DDT4	8/6	VR65	2/6	6K8	9/6
DDT13	8/6	VT52	8/-	6L6G	9/-
DF91	8/-	VU33	4/-	6N7	7/-
DH73M	10/-	V872	4/-	6Q7	9/6
DL74	9/6	XHL5	4/6	6SA7	8/-
EB34	6/6	XPL5	4/6	6SK7	6/-
EBC33	12/6	X73M	9/6	6SL7	7/6
ECH35	13/6	Y63	9/-	6Z4	5/-
EF36	6/-	ILD5	5/6	6X5	7/6
EF39	9/6	IS5	9/-	62BT	10/-
EL32	10/6	IT4	8/-	7A7	9/6
EL33	12/6	IV	10/6	7C5	8/6
EL50	12/6	2A6	2/-	7C6	8/6
H63	7/6	2X2	8/-	7B7	8/6
HL23DD	8/-	37	7/6	7S7	8/6
HL4	8/6	3A4	7/-	7V7	9/6
HL13	10/6	3D6	5/-	7Z4	8/6
KT63	76	4D1	3/-	7193	6/6
KT66	9/-	4SH	8/6	72	10/6
KT72	12/6	50L6G	9/-	78	7/6
KT81	8/6	5U4G	8/6	807	6/6
KTW62	8/6	5Y3	7/6	84	8/6
KTW63	8/6	6AC7	7/6	866a	9/6
KTW73	8/6	6BQ6	12/6	9D2	4/-
KTW74	8/6	6B7	7/6	954	4/6
KTZ41	6/-	6B8	6/6	9004	7/6
LD210	3/6	6CB6	12/6	12SK7G	8/-
MS/PEN	8/6	6C4	7/6	12SH7	6/-
ML4	8/6	6C6	6/6	12SR7	8/-
OC3	7/6	6D6	7/3	12Y4	9/-
RK34	4/-	6F5	7/3	1625	8/6
S217	4/6	6F6	7/6	210LF	3/-
SP61	5/-	6F8	9/-	215SG	6/6
TDD4	8/6	6G6G	5/-	230XP	6/6
TDD13	8/6	6H6	3/6	35L6	9/6
U71	8/6	6J5	6/6	35Z4	8/6

RESISTORS



High stability types from ¼-watt to 2-watt. Wire wound vitreous covered wire ended up to 20-watt. High powered types up to 150-watt mostly clip-in. Insulated and non-insulated carbon types preferred valves. High and low powered variable types. Big stocks available—send details of your requirements.

BARGAINS TO CLEAR



This is a miniature type relay with change-over platinum contacts. Bobbins are 250 ohms each. Brand new—limited quantity—7/6 each, post 1/6.

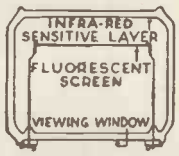
EXPERIMENTERS VALVE SNIP

CV1147, High Current Thyratron, filament 5 v. at 5 amp., peak plate voltage 1,000 v. peak plate current 12 amp. A limited quantity of these are available at 27/6 each.

THERMAL DELAY SWITCH

Hermetically sealed with 4-pin base, the operating voltage is 6 v. with a delay of 1 minute. Alternatively this can be used for overload protection. Approximately 17 milliamps through the heater coil will cause the contacts to close. Useful for many applications such as delaying anode volts until the heaters are properly warmed up. Limited quantity—7/6 each, post and insurance 1/6.

Triode Type CV 1098 this is a high power air-cooled triode. Specification of which is as follows: Filament voltage 8.2 v., filament current 35 amps., anode dissipation 750 watts. Anode volts 25 kv. This valve is very suitable for R.F. heating at high frequencies and two of these in push-pull under Class C conditions would have an output of approximately 2 kilowatts. Brand new, still in original shockproof packing, price £5 each. Carriage and insurance 10/-.



"SNIPER-SCOPE"

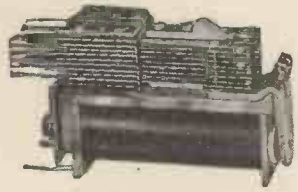
"Cats eye" used for seeing in the dark. Will work burglar alarms, counting circuits, smoke detectors and the hundred and one other devices as will the simpler type of photo cell. Price 5/- each. Post and ins. 1/-. Data will be supplied with cells if requested.

ELECTRONIC PRECISION EQUIPMENT LTD.

249 Kilburn High Road, Kilburn.	42-46, Windmill Hill, Ruislip, Middlesex.	152-153 Fleet St., E.C.4.	29 Stroud Green Road, Finsbury Park, N.4.
Phone: MAI 4921	Phone: RUISLIP 5780	Phone: FLEET 2833	Phone: ARCHWAY 1049
Half-day Thursday.	Half-day Wednesday	Half-day Saturday	Half-day Thursday

Post orders should be addressed to E.P.E. LTD., M.O. Dept. 2, 123, TERMINUS ROAD, EASTBOURNE.
All enquiries to Eastbourne address and please enclose S.A.E., terms are cash with order.

RELAYS P.O. TYPE 3000



BUILT TO YOUR SPECIFICATION

QUICK DELIVERY

KEEN PRICES

CONTACTS UP TO 8 CHANGE OVER

METERS GUARANTEED

F.S.D.	Size	Type	Price
100 Microamp.	2½in.	MC/FR Turner W505	70/-
250 ,, (multirange scale)	3½in.	MC/FR	55/-
500 ,,	2in.	MC/FS	27/6
500 ,, (scaled 0/15 KV)	2in.	MC/FR plug type	18/6
1 Milliamp	2in.	MC/FR	17/6
1 ,,	2in.	MC/FS Elliott 5Q/87	27/6
5 ,,	2in.	MC/FS	10/6
30 ,,	2½in.	MC/FR	12/6
100 ,,	2½in.	MC/FR	12/6
200 ,,	2½in.	MC/FR	12/6
500 ,,	2½in.	MC/FR	12/6
20 Amp.	2½in.	MI/FR	25/-
50 ,,	5in.	MI/PR	60/-
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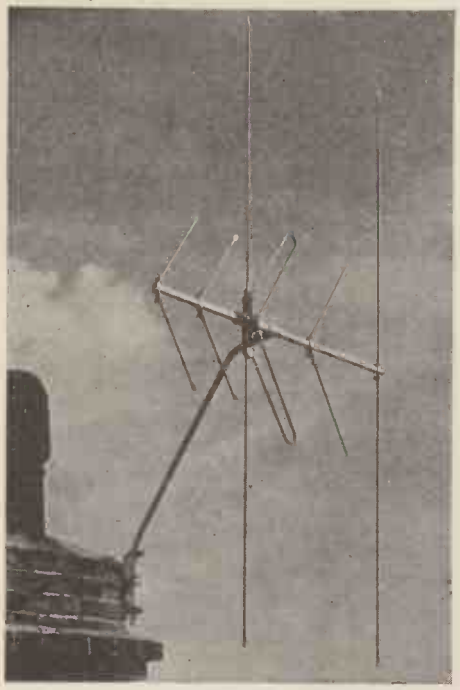

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W.23

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The "Brick" measures 13½" x 6½" x 3" and is a complete unit housing separate record and playback amplifiers, valve voltmeter record level circuit, bias oscillator and all necessary switching; during playback the record amplifier is switched as a power amplifier and will deliver an output of 3 watts into 15 ohms for connection to a suitable speaker.

The units are available in "split" form, e.g. two playback pre-amplifiers may be used for the playback of stereosonic tape records from a stacked head.

Frequency Response	50-10,000 cycles ±2dB 40-12,000 cycles ±4dB
Signal to noise ratio	50dB
Playback amplifier output level	100 mV (Peak)
Output impedance	10,000 ohms (Unbalanced)
Record amplifier input level	10 mV (For max. Modulation)
Input impedance	500,000 ohms (Unbalanced)
Record Level	By Valve Voltmeter
Playback Output	3 watts into 15 ohms.
Power Requirements	6.3 volts at 2.3A. for Heaters. H.T. 300V. at 75 m/A.

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For full information on the Reflectograph Range write to the Manufacturers

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JW.Ad 3922

What the reviewers say about the RD JUNIOR . . . . . .

This month we have devoted our advertisement to extracts from two reviews which have appeared recently dealing with the RD JUNIOR Amplifier and Control Unit. Written by acknowledged authorities in the high fidelity field they speak for themselves . . .

"This amplifier has deservedly established a high reputation for itself. Wherever I have wandered during the past year, I have found universal praise for it from dealers and others who have had an opportunity of putting it through its paces."

"The amplifier is inherently stable under quite adverse conditions of load, and this means not only that high output power can be maintained with low distortion over the whole frequency range, but that the condition of stability will persist even as the valves and other components begin to age. No wonder the makers can afford to give "an unconditional two year guarantee against faulty materials and workamanship."

"The control unit has also been designed to give the utmost that can be expected from an economical unit. It only uses one double triode valve and yet gives not only half a dozen different input arrangements and independent treble and bass controls (the former continuous, the latter in steps) but also a variable steep-cut treble filter without the use of chokes."

"In performance the amplifier has given no surprises: just the clear, crisp, effortless power that one expected from its specification. Which means that it takes a place as one of the best three or four 10-watt amplifiers that are available on the British market at present."

(*The above extracts are taken from TECHNICAL REPORT by P. Wilson, M.A., in the July* 1956 *issue of THE GRAMOPHONE*).

"It can be truthfully stated that the RD JUNIOR is an established product and is widely used as the basis of many average domestic high fidelity systems. For this reason it was chosen by us as one of the equipments installed for record playback purposes in the Gramophone Record Review demonstration room at the London Audio Fair."

"A convenient method is adopted for altering the output matching by means of an appropriate "impedance plug" which is plugged in and the correct feedback resistor (for the three impedances) is automatically placed in circuit."

"The units are constructed on steel chassis heavily primed and stove enamelled in an attractive dark maroon. The components are of first grade with the valve and associated components in the control unit mounted on a floating sub-chassis to avoid microphony. The workmanship is superb, and the neat wiring layout can be seen in our under-chassis view."

"Listening quality is of a high order and I found the controls, particularly the low pass filter used in conjunction with the treble tone control, flexible enough to cope with modern Lp's, old or worn 78's, and poor radio transmissions. Apart from the electrical and mechanical features of this design, the purchaser will be given confidence by the fact that the manufacturer is willing to supply complete circuit diagrams and components lists and guarantee the apparatus (excluding valves) for a period of two years."

"This RD JUNIOR Amplifier/Control Unit exemplifies a much sought after, but not so often achieved, combination of high quality with moderate price."

(*The above extracts are taken from HOME TEST No.* 27 *by Donald W. Aldous in the July* 1956 *issue of the Gramophone Record Review*).

A 12-page Illustrated Booklet devoted solely to the RD JUNIOR Amplifier and Control Unit, together with reprints of the full reviews appearing in the Gramophone and the Gramophone Record Review, post free on request.
Send also for details of companion equipment in the **RD JUNIOR Home High Fidelity System—the RD JUNIOR FM Unit and RD JUNIOR Corner Horn** enclosure.

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Punched chassis 10/6; Gilson Trans. Mains 35/-; Output 25/6. Elstone Trans. Mains 35/-; Output 21/-; Condenser kit 20/-; Resistor kit with 3 pots. 22/6. Complete kit with Genuine Mullard VALVES £8/19/6. Full list available.

MULLARD 510 AMPLIFIER.
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Erie resistor kit, 17/4; Erie 1 meg. pots, 4/6 each; TCC condenser kit, 55/-; PARTRIDGE components with loose lead terminations (includes packing charge), Mains trans., 65/6; choke, 34/6; output trans., 85/6; W.B. components. Choke 18/9; output trans., 32/-; Denco drilled chassis, 14/6; Denco 912 Plus printed panel, 7/6; pre-amp. or passive chassis, 6/-. Full list available.

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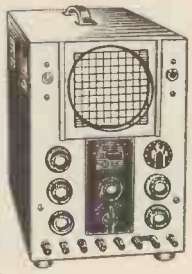

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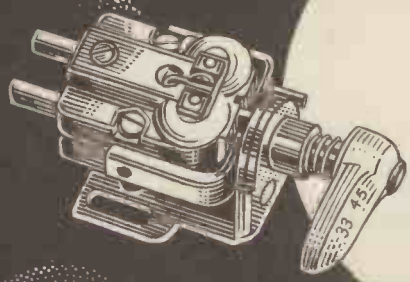

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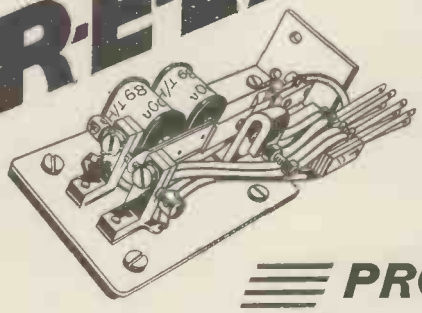

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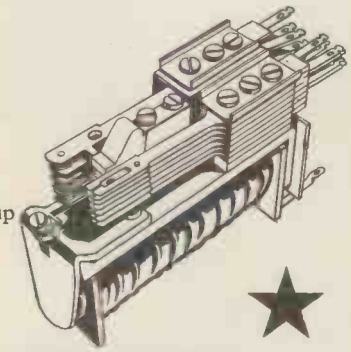

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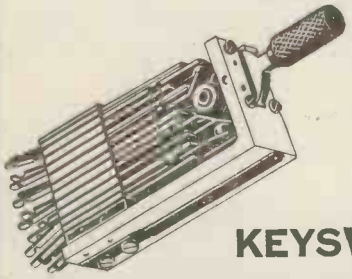
PROMPT DELIVERY



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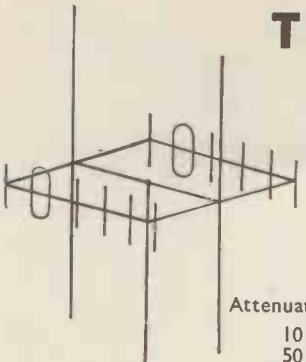

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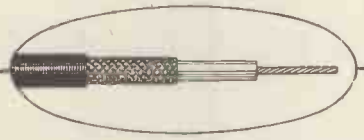
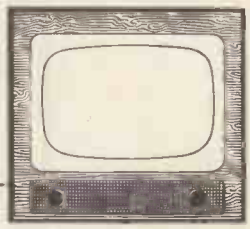
Attenuation db/100 ft.	ET5M	ET6M	ET7M	ET8M	ET10M
10 Mc/s.	1.3	1.5	1.0	1.1	0.6
50 ,,	3.0	3.4	2.3	2.6	1.5
100 ,,	4.3	4.8	3.2	3.6	2.2
200 ,,	6.3	7.2	4.9	5.3	3.3

Dimensions (inches)					
Centre Conductor	1/0.022	7/0.0076	1/0.029	7/0.010	1/0.044
Over Cellular TELCOTHENE	0.093	0.093	0.128	0.128	0.200
Over Wire Braid	0.117	0.117	0.152	0.152	0.230
Over TELECOVIN sheath	0.157	0.157	0.202	0.202	0.290





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★ Less than 2dB Insertion Loss.

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510 CIRCUIT REF. KD245
PRI 8000 ohms A-A (2xEL84)
TAPPED 40% EACH HALF
SEC. 4-8-16 ohms.
INDUCTANCE 290 HYS.
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MAXIMUM

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LEAKAGE 6 mh MAX.
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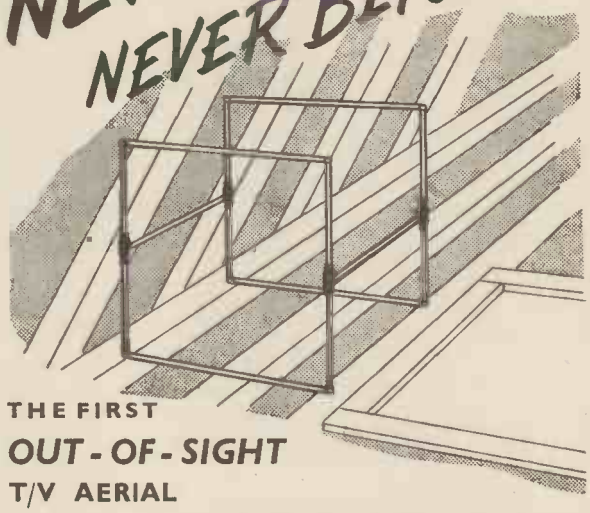

THE FIRST
OUT-OF-SIGHT
T/V AERIAL

BI-SQUARE

FOR BAND I ONLY

(Patent pending)

THE LATEST LABGEAR ACHIEVEMENT IN LOFT AERIALS

Outstanding in design, outstanding in performance . . . yet out of sight too—the new Labgear "Bi-Square" aerial! Yes, here at last is a long-range aerial that need not be a target for wind and weather . . . nor for town-planning criticism either! Note these features of the new "Bi-Square" aerial:

- ★ Stands in any loft—much smaller than the ordinary Band 1 aerial.
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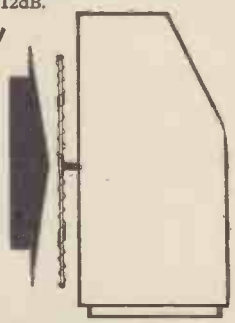
Neat, compact, unobtrusive—approximately 30 inches in length. Simply plug it into the set; no extra fittings, no untidy flex, cables or "extras." Gives reception on both Band I and Band III. Four versions: London, Midlands, North Western and North Eastern. Average maximum range: 10 miles approximately. **And the Spiral sells for only 39/6 complete.**



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MAINS TRANSFORMERS

Primary, 200-250 v. P. & P. 2/-. 300-0-300 100, mA. 6 v. 3 amp., 5 v. 2 amp., 22/6.

Semi-shrouded drop-through 380-0-380 v., 120 mA., 6.3 v. 4 amp., 5 v. 2.5 amp., 22/6.

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Chassis mounting or drop-thro'. Pri. 110-150 v. Sec. 350-0-350, 250 mA., 6.3 v. 7 amp., 6.3 v. 0.5 amp., 5 v. C.T., 0.5 amp. 4 v. 3 amp. P. & P. 3/6. 32/6.

Chassis mounted and fully shrouded, 80 mA. 6 v. 3 amp., 5 v. 2 amp., 14/6.

Drop. thro' 270-0-270 60 mA., 6 v. 3 amp., 11/6.

250 v. 350 mA., 6.3 v. 4 a., twice 2 v. 2 a., 19/6.

Auto-trans. Output 200-250 H.T. 500 v. 250 mA., 6 v. 4 a., twice, 2 v. 2 a., 19/6.

Auto-trans. Input 200-250. H.T. 350 v. 350 mA. Separate L.T. 6.3 v. 7 a., 6.3 v. 1½ amp., 5 v. 3 amp., 25/-. P. & P. 3/-.

Mains transformer, fully impregnated. Input 210, 220, 230, 240. Sec. 350-0-350 100 mA. with separate heater-transformer. Pri. 210, 220, 230, 240. sec. 6.3 v. 2 amp., 6.3 v. 3 amp., 4 v. 6 amp., and 5 v. 2 amp., 30/-. P. & P. 5/-.

350-0-350 75 mA. 6.3 v. 3 a. tap 4 v. 6.3 v. 1 a., 13/6.

500-0-500 125 mA. 4 v. C.T. 4 a., 4 v. C.T. 4 a., 4 v. C.T. 2.5 a., 27/6.

500-0-500 250 mA. 4 v. C.T. 4 a., 4 v. C.T. 5 a., 4 v. C.T. 4 a., 39/6.

6½in. M.E. Speaker. 1,000 ohm field, 15/-.

R. & T.V. Energised 6½in. Speaker, with O.P. trans. field coil. 175 ohm 9/6. P. & P. 2/6.

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Volume Controls. Long spindles, less switch, 50K, 500K, 1 meg., 2/6 each. P. & P. 3d.

Volume Controls. Long spindle and switch, ¼, ½, 1 and 2 meg., 4/- each. 10K and 50K, 3/6 each. ¼ and 1 meg., long spindle, double pole switch, miniature, 5/-. P. & P. 3d. each.

Trimmers. 5-40 pf., 5d. 10-110, 10-250, 10-450 pf., 10d.

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Twin Gang .0005, with feet, size 3½ × 3 × 1½in., 6/6.

3-gang .0005; with feet, size 4¾ × 3 × 1½in., 7/6.

T.V. Coils, moulded former, iron-cored wound for re-winding purposes only. All-can 1¾ × 1¼in., 1/- each, 2 iron-core All-can 2¾ × ¾in., 1/6 each. The above coil formers are suitable for the "Wireless World" F.M. tuner.

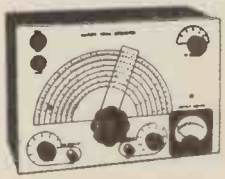
Used Metal Rectifier, 250 v. 150 mA., 6/6. Metal Rectifier, 250 v. 45 mA., 6/-.

Metal Rectifier, RM2, 125 v. 100 mA., 3/6.

OUTPUT TRANSFORMERS

Standard type, 5,000 ohms imp., 4/9, 42-1 with extra feed-back windings, 4/3. Miniature 4-2. 13/3. Multi-ratio 3,500, 7,000 and 14,000, 5/6. 10-watt push-pull, 6V6 matching, 7/-. 90-1 ohm speech coil, 6/6.

SIGNAL GENERATOR



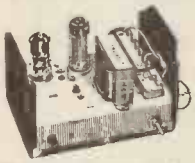
Coverage 120 Kc/s.-84 Mc/s.

A.2 Mains 200/250 v. **£4 - 19 - 6**

Or 34/- deposit, 3 payments of 25/-. P. & P. 4/6 extra.

COMMERCIAL TELEVISION CONVERTER

SUITABLE ANY T.V. using lower side band NO ALTERATIONS TO SET



Complete with built-in power supply, 230-250 v. A.C. mains. Crackle finish case 5¾in. long, 3¼in. wide, 4½in. high. Incorporating gain control and band switch.

£3 - 19 - 6 Plus Post & Packing 2/6.

Illustrated with cover removed.

Less power supply £2/19/6. P. & P. 2/6.

BAND III CONVERTER KIT

comprising 5 channel tuner, mains transformer, metal rectifier, electrolytic, 2 valves 12AT7 and EF80 and all necessary components for A.C. mains operation. Complete with conversion data, £2/5/-. P. & P. 2/6.

4 VALVE ALL-DRY SUPERHET

PORTABLE KIT

Medium and long waves. In grey leatherette. Size 9in. x 7in. x 6in. Valve line up 1T4, 1R5, 1S5, 3V4. Complete kit of parts (less batteries).

£6 - 6 - 0 Plus 2/6 Post and Packing.

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3-SPEED AUTOMATIC CHANGER

Will take 10 Records, 7", 10" or 12" Mixed, turnover crystal head, brand new, current model. A.C. mains 200/250 v. (list price £14/10/-).

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3-speed TRANSCRIPTION MOTOR

BY FAMOUS MANUFACTURER

Complete kit of parts comprising accurately balanced precision made heavy turntable with rubber mat, large constant speed condenser starting motor, base plate. Can be assembled in half an hour. A.C. Mains 200/250 v. Fully guaranteed. Parts sold separately.

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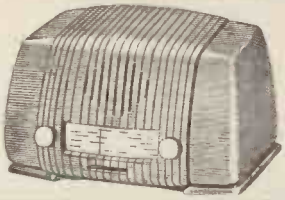
T.R.F. KIT IN PLASTIC CABINET



3 valve plus metal rectifier, A.C. mains 200-250 v. Medium and long waves. In pastel blue or brown. Valve line-up: 2 VR658 and VT52. Size 15¾in. long by 9in. high by 7in. deep. £3/19/6. P. & P. 4/6.

A point-to-point wiring diagram. 1/6. Free with complete kit.

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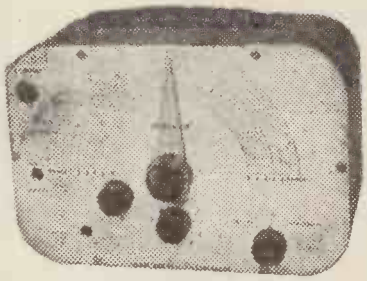

A.C. mains 200-250 v.

£6 - 19 - 6

P. & P. 5/6.

Or £3 deposit P. & P. 5/6 and 3 payments of 30/-.

Germanium Crystal Diode, 1/6, post paid.

Line O.P. Transformer in aluminium can mounted in rubber, 12/6.

Line and E.H.T. Transformer, 14 Kv., using ferrocart core, complete with line and width control, and corona shields U37 rectifier winding, 35/-.

Line and E.H.T. Transformers, 9 Kv., using ferrocart core, complete with built-in line and width control. Mounted on small all-chassis. Overall size 4¾ × 1¾in. EV51 rec. winding, 27/6.

Scan coils, low line low impedance frame, complete with frame transformer to match above 27/6. P. & P. 2/-.

Line and E.H.T. Transformers, 9 Kv. ferrocart core, EY51, heater, winding, complete with scan coils and frame output transformer, and line and width control, 35/-. P. & P. 3/-.

As above, but complete with line and frame blocking transformers, 5 Henry 25 mA. choke, 100 mfd. and 150 mfd. 250 wkg. 380 mA. A.C. ripple, £2/9/6. P. & P. 3/-.

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P.M. Speaker. 6½in. closed field, 18/6. 8in. closed field, 20/6. 10in. closed field, 25/-. 3½in., 16/6. 12in. closed field, 25/-. P. & P. on each, 2/-.

Extension Speaker, in polished walnut, complete with 8in. P.M. P. & P. 3/-. 24/6.

B.S.R. MONARCH

three speed automatic changer, current model. Brand new. Will take 7in., 10in. or 12in., records mixed. Turn over crystal head. A.C. mains 200-250. Pre-Budget Price while stocks last. £7/15/-. P. & P. 3/-.

Standard Wave Change Switches. 4-pole, 3-way, 1/9; 5-pole, 3-way, 1/9; 3-pole, 3-way, 1/9; 9-pole 3-way, 3/6. Miniature type, long spindle, 3-pole, 4-way, 4-pole 3-way and 4-pole 2-way, 2/6 each. 2-pole 11-way, twin wafer, 5/-; 1-pole 12-way single wafer, 5/-. P. & P. 3d.

Ion Traps for Mullard or English Electric tubes, 5/-, post paid.

Standard 465 Kc. iron-cored I.F.s. 4 × 1½ × 1½in., per pr., 7/6.

1,200ft. High Impedance Recording Tape on aluminium spool, 12/6, post paid.

Miniature wire ends moulded. 100 pf. 500 pf. and .001, each 7d.

Combined 12in. mask and escutcheon in lightly tinted Perspex. New aspect edged in brown. Fits on front of cabinet, 12/6. As above for 15in. tube, 17/6.

Frame Oscillator Blocking Trans., 4/6.

Line Osc. Blocking Trans., 4/6.

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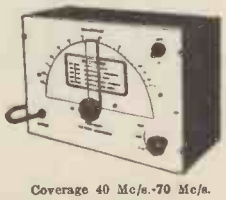
2-20 Hen., 150 mA., 15/-. P. & P. 3/-. 6 Hen. 275 mA., 15/-. P. & P. 3/-. 100 Hen., 40 mA., 15/-. P. & P. 3/-. 250 mA., 10 henry, 10/6; 5 henry 250 mA. 60 ohms., 8/6.

Wide Angle P.M. Focus Units. Vernier adj. state tube, 15/-.

P.M. Focus Unit for Mullard tubes with vernier adjustment. P. & P. 2/-. 15/-.

PATTERN GENERATOR



Coverage 40 Mc/s.-70 Mc/s.

A.C. Mains 200/250 v. **£3 - 19 - 6**

Or 29/- deposit, 3 payments of £1. P. & P. 4/6 extra.

RADIO AND T.V. COMPONENTS (ACTON) LTD.

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GOODS NOT DESPATCHED WHERE CUSTOMS DECLARATION IS APPLICABLE

Terms of Business: Cash with order. Where post and packing charge is not stated please add 1/6 up to 10/-, 2/- up to £1, and 2/6 up to £2. All enquiries S.A.E., lists 5d. each.

UNDOUBTEDLY THE BEST VALUE YET OFFERED

Stern's "fidelity" Tape Recorder

- Extension speaker sockets are provided
- Has dual input channels for mixing
- Monitoring provided for
- Will play the new pre-recorded tapes
- Provides 2 hours playing time at 3¾in. or 1 hour at 7½in. per second
- Will take all standard reels up to 1,200ft.

PRICE COMPLETE READY FOR USE £43

TERMS: £11 Deposit and 9 months of £3/18/3, or £21/10/- Deposit and 12 months of £1/19/10. Carr. and ins. is £1/10/- extra, but we return £1 on return of packing case.

GUARANTEED FOR 12 MTHS. (B.V.A. VALVES 90 DAYS)

SEND S.A.E. FOR ILLUSTRATED AND DESCRIPTIVE LEAFLETS

HOME CONSTRUCTORS ! ! £40/-/-

YOU CAN BUILD THE COMPLETE RECORDER FOR

TERMS: £10 Deposit and 9 months of £3/13/4, or £20 Deposit and 12 months of £1/17/1.

The Truvox TAPE DECK and the Quality Amplifier are supplied tested and ready for use, and the actual assembly of the Tape Recorder is extremely simple, involving only a few connections. Step-by-step connection chart is supplied for this purpose.

f you have your own Cabinet WE WILL SUPPLY: The TRUVOX TAPE DECK, the TAPE AMPLIFIER, MATCHED SPEAKER, and 1,200ft. of E.M.I. TAPE for £33/10/- plus £1/10/- carr. and ins., £1 of which is refunded on return of case.

TERMS: £8/8/- Deposit and 9 months of £3/1/4, or £16/15/- Deposit and 12 months of £1/11/1.

The following items form complete Recorder.

THE TRUVOX MODEL TR7U TAPE DECK

3 Shaded-Pole motors. Drop-in Tape Loading. Push Button Control. Separate Push Button Brake. Fast forward and fast reverse. Silent drive eliminating Wow and Flutter. Half Track working and 2 speeds, 3¾in. and 7½in. per sec. Positive Azimuth Adjustment. Overall size only 14¼ x 12¾in. Available for £23/2/-.

THE MODEL T.R.I./F. AMPLIFIER

Has been expressly designed to meet the requirements of enthusiasts for fidelity reproduction, and in particular to CORRECTLY operate the above TRUVOX DECK. It is supplied complete with a matched Elliptical 3 ohm P.M. Speaker, it incorporates an efficient Tone Control arrangement and has a Magic Eye Indicator (Operative on Record). A Co-axial Socket is also incorporated for MONITORING on Record, and this can also be used to feed an external amplifier. The Amplifier can also be used for high quality reproduction of gramophone records direct from a gram unit. Available for £14/14/-.

ACOS CRYSTAL MICROPHONE MODEL MIC.33.1 Price £2/10/-.

1,200 ft. REEL OF SCOTCH BOY or E.M.I. MAGNETIC RECORDING TAPE. Price £1/15/-.

PORTABLE ATTACHE CASE

Is a neat, compact and attractively finished case, being covered with maroon rexine and having an ivory coloured speaker escutcheon. It contains concealed pockets to accommodate the Microphone, Mains Lead and a spare 1,200ft. reel of tape. Price £5.

Modernise your old Radiogram

WE OFFER the

latest 3 and 4 SPEED AUTOCHANGERS with modern RADIOGRAM CHASSIS and matched P.M. SPEAKERS at REDUCED PRICES. (H.P. Terms available.) A good varied selection is available . . . SEND S.A.E. for ILLUSTRATED and DESCRIPTIVE LEAFLET.

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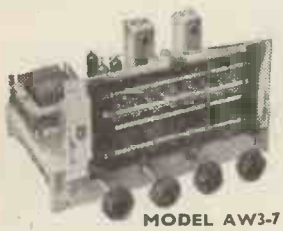
A BULK PURCHASE ENABLES US TO OFFER these RECEIVER CHASSIS at SUCH LOW PRICES. Each is BRAND NEW and FULLY GUARANTEED.

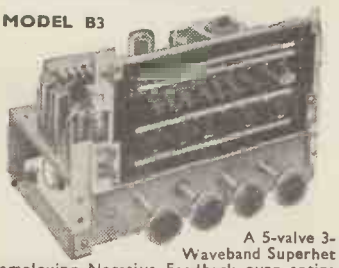


MODEL AW3-7

A 7-valve 3-waveband superhet chassis having a Push-Pull stage for approximately 6 watts output. PRICE **£12-19-6** Plus 7/6 carr. & ins.

H.P. TERMS: Deposit £6/9/9 and 8 monthly payments of 18/9

MODEL B3

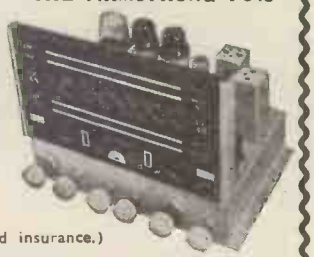


A 5-valve 3-Waveband Superhet employing Negative Feedback over entire Audio Stages and having a single valve type 6BW6 output for approximately 4 watts.

H.P. TERMS: Deposit £5/15/6 and 7 monthly payments of 19/4. PRICE **£11-11-0** Plus 7/6 carr. & ins.

THESE THREE CHASSIS HAVE "GRAM" POSITION and are IDEAL REPLACEMENT CHASSIS FOR THAT "OLD RADIOGRAM"—Send S.A.E. for complete details.

THE ARMSTRONG FC48



A high-quality replacement Radio or Radiogram Chassis having provision for an FM Feeder Unit and incorporating separate BASS and TREBLE CONTROLS. PRICE ASSEMBLED and READY FOR USE **£25/2/0**

(Plus 7/6 carr. and insurance.)

TERMS: £6/6/- Deposit and 9 months of £2/6/- or £12/11/- Deposit and 12 months of £1/3/3.

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PRE-AMPLIFIERS

HIGH FIDELITY FOR THE HOME CONSTRUCTOR

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RADIORECEIVERS

—COMPLETE KITS OF PARTS FOR THE "Hi-Fi" ENTHUSIAST—

The MULLARD '5-10' MAIN AMPLIFIER

This is the very latest design and needs no recommendation from us. Our Kit is complete to Mullard's specification, including the latest GILSON ULTRA LINEAR OUTPUT TRANSFORMER and the entire MULLARD Valve line up. ALL SPECIFIED COMPONENTS are supplied. PRICE OF COMPLETE KIT OF PARTS **£11/11/0**
(Plus 5/- carr. and ins.).

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"A design for the music lover"

Briefly it has inputs for all types of MICROPHONES, HIGH and LOW GAIN PICK UPS and a RADIO TUNING UNIT. It incorporates (a) GRAM EQUALISING CONTROL. (b) STEEPCUT FILTER; (c) Continuously variable BASS and TREBLE CONTROLS and a variable OUTPUT CONTROL which enables its use with any type of Amplifier.
PRICE OF COMPLETE KIT OF PARTS **£6/6/0**
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(Plus 5/- carr. and ins.)

STERN'S HIGH QUALITY 8-10 WATT POWER AMPLIFIER

Comprises the MAIN AMPLIFIER of our very popular 8-10 watt design, which we have modified with the express purpose of its use with the "fidelity" PRE-AMPLIFIER illustrated alongside. TWO 6V6's are used in push-pull and the resultant reproduction is genuinely in the HIGH fidelity class yet the total cost is ridiculously low.
PRICE OF COMPLETE KIT OF PARTS **£7/7/0**
(Main Amplifier only). (Plus 5/- carr. and ins.)

THE full SPECIFICATION and BUILDING INSTRUCTIONS for these three Units are available for 1/6 each. THEY include COMPONENT PRICE LISTS and simple "wire-to-wire" PRACTICAL DIAGRAMS.

SPECIAL PRICE REDUCTIONS . . . FOR PURCHASERS OF A COMPLETE "Hi-Fi" AMPLIFIER

WE WILL SUPPLY (a) COMPLETE KIT OF PARTS to build THE MULLARD "5-10" MAIN AMPLIFIER and the STERN'S "fidelity" PRE-AMPLIFIER-TONE CONTROL UNIT for £16/16/- (plus 7/6 carr. and ins.), or we will supply THE TWO UNITS MADE UP and READY FOR USE for £19/19/- (plus 7/6 carr. and ins.). Terms: Deposit £9/19/6 and 12 monthly payments of 18/7, or £5 Deposit and 9 monthly payments of £1/16/7.
(b) COMPLETE KIT OF PARTS to build the HIGH QUALITY 8-10 WATT POWER AMPLIFIER and the "fidelity" PRE-AMPLIFIER-TONE CONTROL UNIT for £13 (plus 7/6 carr. and ins.) or we will supply THE TWO UNITS MADE UP and READY FOR USE for £15/15/- (plus 7/6 carr. and ins.). Terms: Deposit £7/17/6. 10 monthly payments of 17/9, or £4 Deposit and 9 monthly payments of £1/8/9.
QUALITY OF THIS NATURE HAS NEVER BEFORE BEEN OFFERED AT SUCH LOW COST.

AN F.M. TUNING UNIT for the HOME CONSTRUCTOR

STERN'S "fidelity." A well designed unit that can be completely built for **£10/0/0**

A design comprising a 5-valve line up, using the latest type valves and incorporates the MULLARD PERMEABILITY TUNING HEART and a "Magic Eye" Tuning Indicator. The performance of this Tuner is genuinely up to the new standard of similar Units now being offered at about £20. Attractively finished in "Hammered gold." The complete SPECIFICATION and BUILDING INSTRUCTIONS are available for 1/6, "wire-to-wire" Diagrams are included. All Components are available for sale separately. WE SUPPLY THIS TUNER ASSEMBLED and READY FOR USE. Terms Deposit £7/5/- and 9 monthly payments of 18/4, or £3/18/- Deposit and 9 months of £1/5/11. **£14/10/0**
A design for a COMBINED AM-FM TUNER precisely similar in appearance to the above will be available at end of June. The HOME CONSTRUCTOR will be able to build this for £13/10/-. It provides complete coverage of the F.M. Waveband, and the MEDIUM WAVE-BAND, thereby giving a good selection of foreign stations.

A COMPLETE KIT OF PARTS to BUILD STERN'S "HIGH QUALITY" 8-10 WATT AMPLIFIER

Has power supply available for Radio Tuning Unit.
Price of COMPLETE KIT OF PARTS (plus 5/-carr. and ins.) **£7/10/0**
WE ALSO OFFER IT ASSEMBLED and READY FOR USE for **£9/10/0**
(plus 5/- carr. and ins.)
This amplifier has proved one of the most popular models yet offered to the HOME CONSTRUCTOR. It provides really excellent reproduction up to 8 watts, employing 6V6's in push pull and incorporating negative feedback. Provides for the use of both 3 and 15 ohm speakers. The Complete SPECIFICATION and BUILDING INSTRUCTIONS are available for 1/6.
"Wire-to-Wire" Diagrams are included and all Components are available separately.

STERN'S "COMPACT 5" AMPLIFIERS

EXPRESSLY DEVELOPED FOR VERY HIGH QUALITY REPRODUCTION OF GRAM. RECORDS AND PARTICULARLY SUITABLE FOR HIGH QUALITY REPRODUCTION OF THE F.M. TRANSMISSIONS: TWO MODELS ARE AVAILABLE:

The "Compact 5-2"
A 2-stage high sensitivity amplifier having SEPARATE BASS and TREBLE CONTROLS and designed to give up to approx. 5 watts with very pleasing quality. PRICE £5/15/- (plus. 5/- carr. and ins.).

The "Compact 5-3."
A 3-stage version of the "5-2" model but in this case having an additional stage and incorporating negative feedback. PRICE £6/16/- (plus 5/- carr. and ins.)

The Amplifiers are compact and very attractively designed, having a Bronze/Gold finish with a fully engraved front panel by which the entire Amplifier is conveniently mounted into a Cabinet, occupying no more space than a conventional Tone Control Unit. Fully described in our Leaflets.
POWER SUPPLY A separate small Unit is available and this in addition to supplying power to the Amplifier has additional power available for RADIO TUNING UNIT, etc. PRICE £2/10/-.

STERN'S POWER SUPPLY UNITS

These units are fully smoothed with all output connections terminated to connecting blocks, thereby enabling case of connecting to a Radio Tuner Unit or Amplifier etc. Overall size is 9½in. × 3½in. × 4½in. Two Units are available. Type "A" Unit . . . Incorporates type 6X5 Valve and provides 250-300 volts at up to 70 mA. and 6.3 volts at 3½ amps.
PRICE OF COMPLETE KIT OF PARTS **£2/9/6**
ASSEMBLED AND READY FOR USE **£2/17/6**
(Carriage and insurance 2/6 extra).
TYPE "B" UNIT. Incorporates type EZ81 valve and provides 250-300 volts at up to 100 mA. and 6.3 volts at 3½ amps.
PRICE OF COMPLETE KIT OF PARTS **£2/15/0**
ASSEMBLED AND READY FOR USE **£3/3/0**
(Carriage and insurance is 2/6 extra).
The WIRING DIAGRAM IS AVAILABLE SEPARATELY FOR 9d.

STERN'S BATTERY PORTABLE for the HOME CONSTRUCTOR

This is a completely NEW DESIGN and we cannot at the time of going to press produce an illustration. It incorporates the NEW "ECONOMY" MINIATURE VALVES, and these have about half the battery consumption of the standard valve line-up normally incorporated in this type of Portable Set—batteries will therefore last about TWICE AS LONG. The Set comprises a 4-valve Superhet design covering both LONG and MEDIUM WAVEBANDS and incorporates a Goodmans 5in. PM Speaker. Tone therefore is very good whilst volume and station selection is excellent. Accommodated in a robust but very attractive rexine covered ATTACHE CASE.
THE COMPLETE RECEIVER (including ATTACHE CASE) can be built for **£8/12/6**
The ASSEMBLY MANUAL which contains "wire-to-wire" diagrams is available for 1/6.
ALL COMPONENTS are available for sale separately.

RECORD PLAYERS

THE VERY LATEST MODELS ARE OFFERED AT GREATLY REDUCED PRICES

★ TRANSCRIPTION UNITS ★ 3 and 4 SPEED AUTOCHANGER ★ AUTOCHANGERS with MANUAL CONTROL POSITION.
Send S.A.E. for ILLUSTRATED and DESCRIPTIVE LEAFLET. This Leaflet also contains data of a PORTABLE TYPE GRAM AMPLIFIER which has separate BASS and TREBLE CONTROLS (PRICE £4.12.6. INCLUDING 6½" P.M. SPEAKER) and an attractive PORTABLE CARRYING CASE

EXCEPTIONAL OFFER FOR CASH ONLY

The B.S.R. MONARCH 3-SPEED AUTOCHANGER is offered for **£7/7/0** (plus 5/- carr. and ins.)

- These units will autochange on all three speeds, 7in., 10in. and 12 in.
- They play MIXED 7in. 10in. and 12in. records.
- They have separate sapphires for L.P. and 78 r.p.m., which are moved into position by a single switch.
- Minimum baseboard size required 14 × 12½in., with height above 5½in., and height below baseboard 2½in. A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price.

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LP 312-2

LABORATORY BALANCED. The TSL LORENZ LP312-2 is a main bass, 12in. diaxial speaker combined with two LPH65 electro-magnetic high frequency TREBLE units permanently mounted coaxially across the front of the main bass speaker at such an angle to give full spherical binaural response. All are laboratory balanced and matched for perfect tone with a frequency range of 20 cycles to 22,500 cycles essentially level output. To ensure level frequency response the voice coils of the two treble speakers are fed through a specially designed crossover network which balances the frequency response of the three speakers as a combined unit.

IMPROVE ANY

LPH65

The TSL LORENZ LPH 65 is the basic treble speaker used in the TSL LORENZ Sound System. Round in shape to ensure smooth, melodious sound the plastic cone is fully tropicalised. Special features are the super high flux density magnet of 17,500 gauss and non-perforated back plate.

SOUND SYSTEM

SPECIFICATION LP312-2

IMPEDANCE 15 ohms; **FREQUENCY RANGE** 20-22,500 c/s; **POWER RATING** 25 w.; **PEAK POWER RATING** 40 w.; **DIAMETER** Bass 12¼ inches, Treble 2½ inches; **DEPTH** Bass 7⅛ inches Treble 2 inches; **BAFFLE OPENING** 10⅞ inches; **SPEECH COIL DIAMETER** Bass 1.5 inches, Treble ½ inch; **FUNDAMENTAL RESONANCE** Bass 20 c/s., Treble 1,600 c/s.; **FLUX DENSITY** Bass 17,500 gauss, Treble 17,500 gauss; **INTERMODULATION PRODUCTS** under 0.5%; **CROSSOVER FREQUENCY** 2,000 c/s; **FINISH:** Grey and blue vitreous anti-corrosion stove enamel.

RETAIL PRICE £14.19.6 (not subject to Purchase Tax).

SUPER HIGH FIDELITY THIS YEAR

Let your ears be your judge . . . crisp clear, natural reproduction without coloration with TSL LORENZ speaker units. Ten years ahead in engineering and design, this speaker unit will enable you to design and build up a sound system in your own home which will truly add the miracle of LIFE to the magic of music . . .

No Extra Cost. You get these extra features at no extra cost with every TSL LORENZ Sound system . . . Greater output and more sensitivity . . . heavy duty oversize speech coil . . . Super high flux magnet . . . Permanently flexible self-damped cone . . . Multi-parameter cone fully tropicalised . . . Sealed in air gaps . . . built-in centralizing device for perfect gap alignment.

Improve your own H.F. Sound System. *For those devotees of high fidelity who possess bass speakers fitting one or more LPH65 treble units will greatly extend your range of super fidelity reproduction. They are, without a doubt, the most sensitive and efficient treble reproducers research has revealed to date. The non-perforated back plate ensures that the LPH65 can be used with any other speaker irrespective of make or type without interaction taking place.*

SPECIFICATION LPH65

HIGH FREQUENCY CONE-HORN TYPE TREBLE UNIT. IMPEDANCE 5.5 ohms; **FREQUENCY RANGE WITH SUITABLE HIGH PASS FILTER CONDENSER** 2,000 22,500 c/s; **POWER RATING AS A SINGLE UNIT** 3 w.; **PEAK POWER RATING AS A SINGLE UNIT** 5 w.; **DIAMETER** 2½ inches; **DEPTH** 2 inches; **BAFFLE OPENING** 2⅛ inches.

PRICE 39/6. (including Purchase Tax).

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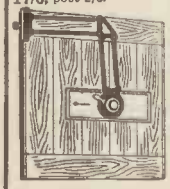
HUGHES 12-VOLT D.C. SHUNT MOTORS, taking 1.25 amps., up to 2-amps. on load, speed 5,000 r.p.m., external reversing terminations, size 3½in. long, 1½in. dia., ¼in. dia. shaft, weight 20 oz., oil impregnated bearings, balanced armature, a very superior powerful motor, original cost over £7, our price new unused 10/-, post 1/3, 2 for 20/-, post paid. Ditto, fitted reduction gears, giving a final drive of either 320 or 160 r.p.m. (state which required), 12/6, post 1/6, 2 for 25/-, post paid.

HAND GENERATORS, fitted gearbox and detachable handle, generates 28 v. L.T. and 300 v. H.T., with data to convert in a few minutes to an efficient 200/250 v. A.C./D.C. motor with final drives of approx. 60, 12 and 2 r.p.m. unused and perfect, 17/6, post 2/6.



NAVIGATORS CHART BOARDS, selected 7-piece polished wood 17in. × 17in. by ¾in. thick, fitted brass parallel motion drawing arm, hinged to board edge, slide with lock screw, free arm end fitted protractor scale marked in degrees, also ruled Perspex transparent straight edge 10in. × 3in. by ⅛in. thick, each with locking device, board back has felt fitted feet with pencil holder, these are brand new and boxed, value 70/-, our price 25/-, post 2/6, 2 for 50/-, post paid.

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TRANSISTORS, germanium junction P.N.P., by the leading manufacturers in this country, complete with data, 10/-, post 3d.

SLYDLOK FUSES, 5-amp. back terminations, brand new, 1/6, post 4d., 15/- doz post 1/1, ditto 15-amp. end terminations, brand new, 1/6, post 4d., 15/- doz., post 1/3

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3-speed with T.O. crystal head HI/G, and rest. Brown plastic. Post 2/6. **42/6**

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L.P. and standard, complete with styli. Per pair, **79/6** Post 3/6.
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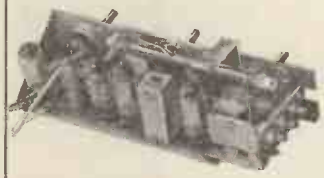

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- ★ PRINTED CIRCUIT, size 7½in. × 2½in.
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- ★ Lightweight and Handsome Appearance.
- ★ Every Component available separately.

CAN BE BUILT FOR £7.7.0 approx.

SEND FOR CIRCUIT DIAGRAM with assembly data, all instructions illustrations and full shopping list. Price 1/6 post free.

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As illustrated, complete with t.o. crystal pick-up. Cabinet space required 14 × 12¼ × 4in. above and 2⅞in. below motor board. Cream and brown enamel finish. Complete with instruction book. List £14/13/-.

LASKY'S PRICE £7.19.6

Carr. 3/6. Cabinet available, see special offer on right.

GARRARD RC.80. Full length arm with two Decca XMS heads. List £20/15/-.
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3in. and 3½in.				19/6
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FAMOUS MAKE TURRET "TELETUNER"

Complete with Coil Sets.

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Covers all Channels, Bands 1 and 3. Valves used: PCC84, R.F. double triode, cascode R.F. amplifier, PCF80, triode pentode f.c. and mixer. I.F. output 33-38 Mc/s. Easily modified to aother I.F. outputs. Full instructions and circuit diagram supplied.

SPECIAL OFFER!

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2 valves and metal rectifiers, metal case. Contains power pack for 200-250 v. A.C. List £8/10/-.
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VALRADIO TV TUNERS

Full range, all I.F. freq., series or parallel heaters, Post 3/6. **£6**

MAKE YOUR OWN FERRITE ROD AERIAL. Ferrite rod, 5in. long, ¼in. diam., with full directions. Each, 2/6. Post 1/-.

20,000 VALVES IN STOCK

Here are a few examples of brand new surplus and imported valves:-

EB91	7/6	EF41	10/6	EY51	12/6
EB41	7/6	EF80	10/6	EC84	11/6
EABC80	10/-	EF85	10/6	EY86	14/6
EAF42	10/-	EF86	12/6	EZ40	8/6
EBC41	10/-	EF89	10/-	EZ80	8/6
ECC85	10/-	6K8	10/6	PCF82	12/6
ECC84	15/-	6V6	8/6	PCC84	12/6
ECC83	9/-	6K7	5/6	PL81	13/6
ECC82	9/-	6Q7	10/6	PL82	10/6
ECC81	9/-	6R7	6/6	PL83	11/6
12AT7	8/6	5Z4	9/6	PY80	10/6
12AU7	8/6	DAF96	10/-	6AT6	7/6
12AX7	9/6	DL96	10/-	6AT7	7/6
ECF82	15/-	DK96	10/-	1S5	7/6
ECH42	11/6	DF96	10/-	3S4	7/6
ECH81	11/6	Set of 4	32/6	1T4	7/6
ECL80	11/6	DM70	9/-	1R5	7/6

Also full stocks of B.V.A. Valves and C.R. Tubes at the new lower list prices.
WRITE FOR COMPLETE LIST.

DULCI F.M. TUNER

Incorporates its own power supply and provides complete F.M. coverage. Operates with most radio receivers and any make of Amplifier. Valve line-up EABC80 ECC85, two EF89, 6X4 (Rect.), EM80 Indicator. Incorporates GORLER Inductance Tuning Heart, and magic eye tuning indicator. Dial 10½ × 6in. Overall size 9 × 6 × 5½in. high. Complete **16 Gns.**
Carr. & Pkg. 7/6

THE NEW JASON "ARGONAUT" AM/FM TUNER

A super-sensitive Tuner for F.M. and medium waves. The complete parcel with power supplies, Post 3/6. **£13/19/6**

Data Book 2/-, post free.

All components available separately. Send for itemised price list.

Chassis Assembly, complete, 57/9. Post 2/6.

I.F. and Coil Set, complete 78/-. Post 1/6.

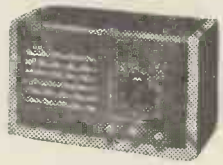
JASON F.M. TUNER

Special parcel containing data book, chassis, front panel, dial, drive, tuning condenser, full set of coils, I.F.s, ratio detector, etc. **68/9** Post 2/6.

Book only, with price list, 2/-. This Tuner uses 4-6AM6 and 2 crystals and can be built for £6/15/-, plus 3/6 post.

★ LASKY'S RADIO CONSTRUCTOR PARCELS ★

With your choice of Cabinets as illustrated.



PARCEL No. 1

Contains everything to build a 4-valve 3-wave superhet for 200/250 A.C. mains. Uses 6K8, 6K7, 6Q7, 6V6 valves. Attractive wood cabinet, walnut veneer, or plastic cabinet as illustrated. Size 12 × 6½ × 5½in. deep. CAN BE BUILT FOR **£7/19/6**
Carr. and packing 2/6.

PARCEL No. 2

Contains everything to build a T.R.F. 3-valve set for 200/250 A.C. mains, medium and long wave. Uses 6K7G, 6J7, 6V6, and metal rectifiers. Neat plastic cabinet, walnut or ivory finish, or wood cabinet. Size 12 × 6½ × 5½in. deep. CAN BE BUILT FOR **£5/10/-**
Carriage and packing 2/6.

INSTRUCTION BOOK for either above sets 1/- post free.
CABINETS ONLY, plastic or wood, 17/6. Carriage 2/6.
All components available separately.

BUILD THIS FIRST CLASS TAPE RECORDER AT POUNDS SAVING

LASKY'S PORTABLE TAPE RECORDER KIT

- Fully fitted portable case as illustrated 59/6
- Truvox Deck, latest type, 22 gns.
- Tape Recorder Amplifier, 12 gns.
- 7 x 4 Elliptical Speaker, 19/6
- E.M.I. Tape, 1,200 feet, 35/-
- 7in. Plastic Spool 4/6

LASKY'S PRICE FOR THE COMPLETE KIT **£35**
Carr. & Pkg. 25/-.

SPECIAL REDUCTION!

COMPLETE 5-VALVE RADIO CHASSIS

Brand new and unused. A.C./D.C. 200/250 volts. I.F. 465 kc/s. A.V.C., 4 watts output, 3-station pre-set, frame aerial, fully aligned, chassis 10 x 5½in., max. height 5½in. Completely wired and ready for use, with the addition of a speaker and output transformer. Two controls, volume and station switch. Valves used: 10C1, 10F9 or UF41, 10LD11, 10P14, U404 or UY41.

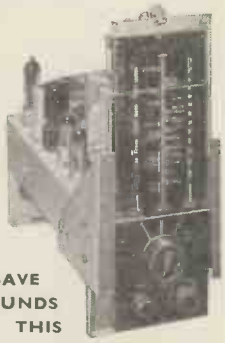
REDUCED TO **52/6** less valves. Post 3/6 extra.

FAMOUS AMPLIFIERS BUILT ON T.C.C. PRINTED CIRCUITS

All specified components used, with your choice of transformers and chokes. Fully assembled and ready for use.

The **MULLARD 510.** Price, according to transformers used, from 15 gns. The Book, 3/6.

OSRAM 912. From 19 GNS. The Book, 4/-, post free.
All components available separately, also printed Circuits.



SAVE POUNDS ON THIS

6-VALVE RADIOGRAM CHASSIS COMPLETE WITH VALVES

Famous Manufacturer's Surplus. 6 valve 3-wave Superhet. 13-50 m. short. 200-550 m. medium, 1,000-2,000 m. long. Brand new Mullard valves: ECH42, EF41, L63, EB41, 6V6 g.t., EZ40 and finest quality components. Gram. switch, 465 kc/s I.F., tone control, three-colour dial. Overall size 13½ × 5in., height 12½in. Aperture required for dial and controls 11 × 3½in. Complete with valves, output trans., knobs, etc.

LASKY'S PRICE **£10/19/6**
Carriage and packing 7/6 extra.

5-VALVE RADIOGRAM CHASSIS

A.C. mains, 3-wave superhet. Large full vision dial, 11½ × 4½in. Overall dimensions 14 × 6 × 7in. Valve line-up: 12AH8, 6BA6, 6AT6, 6BW6, 6X4.

LASKY'S PRICE, complete with valves, Carr. 7/6 **£9/19/6**

Table Cabinet for above, complete with 6½in. P.M. speaker, 49/9

MORE MONEY-SAVING LASKY BARGAINS ON NEXT PAGE

EVERYTHING FOR HOME CONSTRUCTOR & SERVICEMAN

LASKY'S RADIO

LARGE RANGE OF TAPE DECKS

Collaro "Tape Transcripter," £20
Truvox 22 Gns.
Lane, £18/10/-.
Brenell, 18 Gns.
And all other makes.

LATEST BRENELL TAPE EQUIPMENT

Deck. 3-speed, 3 motors, record and play back. 18 Gns.

Amplifier Mk. II. 5 watts, for use with 3 ohms speaker. Magic eye. 18½ Gns.

Carrying Case, £4/18/-.

Complete equipment with mike and tape, in carrying case, ready for use. 51 Gns.
Full details on request.

RECORDING TAPE

SPECIAL OFFER. Magnetic Recording Tape, kraft base. On Cyldon metal spools: 1,200ft., 11/6; 600ft., 7/6.
On plastic spools: 1,200ft., 12/6; 600ft., 9/6.
PURETONE TAPE on plastic spool: 1,200ft., 14/11.
All above, 1/- extra by post.
All makes of Tape including the new thin long-playing in stock. Also all types of Spools.

SPECIAL OFFER OF TAPE DECK MOTORS

Anti-clockwise, shaded pole.

Collaro	Garrard	B.T.H.
25/-	26/6	29/6

Post extra

Special Bargain

3-WATT AC/DC MIDGET AMPLIFIER

Push pull, very high gain. 4 valves: two UL41 (p.p.), UCH42, UAF42. Input voltage 100/110 A.C./D.C. Easily converted to 230 v. Ideal for record players, tape recorders, baby alarms, etc. Supplied fully assembled with valves, circuit diagram and details.
REDUCED TO **50/-** Carr. 5/-.

REMPLOY INSTRUMENT SOLDERING IRONS.

200-250 v. Neon indicator light in handle. **19/3**

GERMANIUM CRYSTAL DIODES

GEX.00	1/6
GEX.34	3/6
GEX.54 and OA71	5/-
WG4A	3/6
WG4B	4/-
WG5A and B	5/-
WG6A	5/-

PROJECTION TV UNITS

(Mullard.) Consisting of optical unit and E.H.T. unit, complete with valves and C.R. tube. Limited quantity. Full details on request.
LASKY'S PRICE **£21**
Carr. 21/-

PORTABLE GRAM AMPLIFIER

Uses 3 latest miniature valves, U78, N78, DH77. Volume, bass and treble controls; extension L.S. socket and internal L.S. switch, indicator lamp. Mounted on wood baffle, overall size 14 × 4½in. with speaker centralised. All top quality new components. For A.C. mains, 200-250 v. Ideal for portable record players, input will match Monarch, RC54, 3/554, etc.
Price, complete with 3 new Osram valves, 7 × 4in. Goodmans elliptical speaker, metal speaker grille, mains lead, and knobs. **£5.9.6** Carr. 5/-

BIGGEST BARGAIN EVER OFFERED IN TV CATHODE RAY TUBES !

BRAND NEW, PERFECT 16" METAL CONE C.R.T.

A big new purchase of these tubes enables us to still further reduce our price from £9.19.6 to £8.9.6.

LISTED AT £23.9.10

LASKY'S PRICE

£8.9.6 Carr. & Insur., 22/6 extra.

Here is your opportunity to convert to big picture television at a price you can afford. Note especially that these are not "seconds" but perfect tubes without fault, and supplied in original cartons. Brief specification: 6.3 v. heater, ion trap, 14 Kv. E.H.T., wide angle 70 deg. standard 38 mm. neck, duodecal base, magnetic focus and deflection. Max. length 17$\frac{11}{16}$in. Gives large 11 × 14$\frac{3}{8}$in. black and white picture. GUARANTEED BY US FOR 3 MONTHS. Full data, connections and suggested time bases supplied with every tube.

Masks, Anti-Corona Rings, Bases and Ion Traps available.

Note to Previous Customers : As a gesture of goodwill to customers who paid our former price of £9.19.6, we will make a rebate of £1.10.0 in the form of a merchandise credit note. Proof of purchase must be furnished and claims must be made by September 14th, 1956.

MAINS TRANSFORMERS

All 200-250 v. 50 c.p.s. primary, finest quality, fully guaranteed. **MBA/3.** 350-0-350 v. 80 mA. 6.3 v. 4 a., 5 v. 2 a. Both filaments tapped at 4 volts. 19/6. **MBA/7.** 250-0-250 v. 80 mA. 6.3 v. 3 a., 5 v. 2 a. Both filaments tapped at 4 volts. 19/6. **AT/3.** Auto trans. 0-10-120, 200-230-240 v. 100 watts. 19/6. **MT/340.** Tapped input 200/250 v. 300-0-300, 100 m/A, 5 v. 3 amp., 6.3 v. 1.5 amp. 16/6. **MT/341.** Tapped input 250-0-250, 120 m/A., 6.3 v. 5 amps., fully shrouded. 27/6.

MICROPHONE SNIP

Table Crystal type, with screened lead. **21/-** Post 2/6.
Large selection of all types.

MAKERS' SURPLUS TV COMPONENT BARGAINS

WIDE ANGLE 38 mm.

Line E.H.T. trans., ferrox-cube core, 9-16 kV.	25/-
Scanning Coils, low imp. line and frame	25/-
Ferrox-cube cored Scanning Coils and Line Output Trans., 10-15 kV, EY51 winding. Line Trans. incorporates width and linearity control. Complete with circuit diagram, the pair	50/-
Frame Output Transformer	6/6
Scanning Coils low imp. line and frame	17/6
Frame or line blocking osc. transformer	4/6
Focus Magnets Ferrox-dure	19/6
P.M. Focus Magnets, Iron Cored	19/6
Duomag Focalisers	22/6
300 m/a. Smoothing chokes	15/-
Electromagnetic focus coil, with combined scan coils	25/-

STANDARD 35 mm.

Line Output Transformers. No E.H.T.	12/6
Line Output Transformers 6.9 kV. E.H.T. and 6.3 v. winding. Ferrox-cube	19/6
Scanning coils. Low imp. line and frame	12/6
Ditto by Igranic	14/6
Frame or line blocking oscillator transformer	4/6
Frame output transformer	7/6
Focus Magnets:	
Without Vernier	12/6
With Vernier	17/6
Focus Coils, Electro-magnetic	12/6
200 m/a. Smoothing Chokes	10/6

R1155 RECEIVERS

NOW AVAILABLE ON EASY TERMS

In original wood transit cases. Brand New	£11 19 6
Secondhand, Grade I	£9 19 6
Ditto, Grade 2	£7 19 6
Carr. 12/6	
Power Pack and Output Stage with 6½in. Speaker	£5 5 0

FILAMENT TRANSFORMERS

All 200-250 v. 50 c.p.s. primary, finest quality, fully guaranteed.

6.3 v. 1.5 amp.	5/11
6.3 v. 2 amp.	7/6
6.3 v. 1 amp.	4/6
0-30 volts	19/6

BAND III AERIALS. All types, outdoor or indoor, also Diplexes, Crossover Boxes, Co-axial Plugs, Sockets and Cable.

LASKY'S RADIO

LASKY'S (HARROW RD.) LTD.

TWO ADDRESSES FOR PERSONAL CALLERS
OPEN ALL DAY SATURDAY EARLY CLOSING: THURSDAY.

42 TOTTENHAM COURT ROAD, W.1.
Between T.C.R. and Goodge St. Stns.
MUSeum 2605

370 HARROW ROAD, PADDINGTON, W.9.
(Opposite Paddington Hospital)
LAD 4075 and CUN 1979

ALL MAIL ORDERS TO HARROW ROAD PLEASE

R.S.C. BATTERY CHARGING EQUIPMENT

All for A.C. MAINS 200-250v., 50 c/cs. Guaranteed 12 months.

ASSEMBLED CHARGER v. or 12 v. 2 amps. Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case, finished attractive hammer blue. Ready for use with mains and output leads, Double Fused. Only **46/9** carr. 3/6.

ASSEMBLED CHARGERS
6 v. 1 amp 19/9
6 v. or 12 v. 1 amp. .. 25/9
6 v. 2 amps. 29/9
6 v. or 12 v. 2 amps. .. 38/9
6 v. or 12 v. 4 amps. .. 56/9
Above ready for use. Carr. 2/9

HEAVY DUTY KIT
12 v. 30 amp. Suitable for garage or firm with a number of vehicles. Mains input 200/250 v. 50 c/s. Outputs 12 v. 15 amp. twice. Consists of Mains Trans. 2 Metal Rectifiers. 2 Meters. 4 Fuses. 4 Terminals. 2 Rheostats and circuit. Only 9 gns., carr. 15/-.

BATTERY CHARGER KITS Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case, Fuses, Fuse-holders, Grommets, panels and circuit. Carr. 2/6 extra.
6 v. or 12 v. 1 amp. .. 22/9
6 v. 2 amps. 25/9
6 v. or 12 v. 2 amps. .. 31/6
6 v. or 12 v. 4 amps. .. 49/9

BATTERY CHARGER KIT Consisting of F.W. Bridge Rectifier 6/12 v. 5 a. Mains Trains., 0–9–15 v. 6 a. output, and variable charge rheostat with knob. Only 45/9. Post 3/-.

Assembled 6 v. or 12 v. 4 amps. Fitted Ammeter and variable charge selector. Also selector plug for 6 v. or 12 v. charging. Double fused. Well ventilated steel case with blue hammer finish. Ready for use with mains and output leads. Carr. 3/9. **69/6**

SELENIUM RECTIFIERS

L.T. Types		6/12 v. 6 a. ..	19/9
2/6 v. ½ a.h.w.	1/9	6/12 v. 10 a. ..	25/9
6/12 v. ½ a.h.w.	2/9	**H.T. Type H.W.**	
F.W. Bridge Types		120 v. 40 mA.	3/9
6/12 v. 1 a. ..	5/9	250 v. 50 mA.	5/9
6/12 v. 2 a. ..	8/9	250 v. 80 mA.	7/9
6/12 v. 3 a. ..	12/9	250 v. 150 mA.	9/9
6/12 v. 4 a. ..	16/9	300 v. 275 mA.	12/11

CO-AXIAL CABLE. 75 ohms, ¼in., 8d. yard. Twin screened feeder, 11d. yard.

5 CORE FLEX. Henleys circular rubber 14/36. Each lead colour coded. 1/6 yd.

T.V. CABINETS. For 15, 16 or 17in. tube. Table model with doors, 79/6, carr. 7/6. Table type for 12in. tube, 27/6, carr. 5/6. All leading manufacturers surplus.

SILVER MICA CONDENSERS. 5, 10, 15, 20, 25, 30, 35, 50, 100, 120, 150, 180, 200, 230, 300, 330, 400, 470, 500, 1,000 pfd. (.001μF). .002 mfd. (2,000 pfd.). All at 6d. each, 3/9 dozen one type.

DIAL BULBS, M.E.S., 8 v. 0.2 a., 6/9 doz. 6.5 v. 0.3 a., 6/9 doz.

ELECTROLYTICS (current production). NOT Ex Govt.

Tubular Types		Can Types	
8μF 450v. ..	1/9	8 mfd. 600 v.	2/11
8 mfd. 500 v.	2/6	16 mfd. 350 v.	1/11
16μF 350 v. ..	2/3	16μF 450 v. ..	2/9
16μF 450 v. ..	2/9	16 mfd. 500 v.	3/9
16μF 500 v. ..	3/9	32μF 350 v. ..	2/11
32μF 350 v. ..	3/9	32 mfd. 450 v.	4/9
32 mfd. 500 v.	5/9	100 mfd. 450 v.	4/9
8-16μF 500 v.	4/11	8-8μF 450 v. ..	2/9
25μF 25 v.	1/3	8-16μF 450 v.	2/11
50μF 12 v.	1/3	16-16μF 450 v.	3/11
50 mfd. 25 v.	1/9	16-32μF 350 v.	4/9
50μF 50 v.	1/9	32-32μF 350 v.	4/9
100 mfd. 12 v.	1/9	32-32μF 450 v.	5/9
100 mfd. 25 v.	2/3	64-120 mfd. 350v.	7/6
		100-200 mfd. 275 v.	6/11

Many others in stock.

VOLUME CONTROLS with long spindles, all values, less switch, 2/9; with S.P. switch, 3/9.

VIBRATORS. Oak 2 v. 7 pin, synchronous, 7/9.

EX GOVT. E.H.T. CONDENSERS
.5 mfd., 2,500 v. Blocks 3/9
.1 mfd. plus 1 mfd. 8,000 v., large blocks (common negative isolated) 9/6

EX GOVT. METAL BLOCK PAPER CONDENSERS

2 mfd. 500 v. ..	1/9	10 mfd. 600 v.	6/9
4 mfd. 500 v. ..	2/8	8-8 mfd. 500 v.	5/11
8 mfd. 500 v. ..	5/9	15 mfd. 500 v.	7/9
4 mfd. 400 v. plus 2 mfd. 250 v.		.....	1/11

EX GOVT. VALVES. VR137, EA50, EB34, 11d.; SP61 2/3; 4SHA 1/3; EL32 3/9; 6X5 4/9.

EX GOVT. UNITS, type RDF1 in original sealed cartons with 14 valves including 5Z4G, etc., trans., L.F. choke, Rectifier, etc., etc. We cannot enter into correspondence regarding these units which represent a really exceptional bargain at 29/9. Carr. 7/6.

CONTROL PANEL with 1 six-position 3-wafer Yaxley switch, 1 pointer knob. 2 S.P.S.T. switches, various plugs and sockets. Only 1/6.

OIL FILLED BLOCK CONDENSERS
Bryce 11-7 mfd. 500 v. New unused Govt. surplus, only 5/9 each.

EX GOVT. MAINS TRANSFORMERS
All 230 v. 50 c/s. input
120-0-120 v. 40 mA. 5/9
300-0-300 v. 150 mA. 4 v. 3 a. 9/9
250-0-250 v. 60 mA. 6.3 v. 2 a., 5 v. 2 a. Potted 4½-3½-3in. 11/9
460 v. 200 mA., 6.3 v. 5 a. 22/9
0-16-18-20 v. 35 a., 79/6. Carriage 7/6 extra.

MANUFACTURERS SURPLUS TRANSFORMERS
Fully shrouded upright. Primary 200-230-250 v. Sec. 425-0-425 v. 150 mA. 6.3 v. 3 a., 5 v. 3 a., 33/9. Clamped type 325-0-325 v. 100 mA. 6.3 v. 3.5 a., 5 v. 2 a. Wearite 19/9. Post 2/9.

EX GOVT. SMOOTHING CHOKES
250 mA., 5 H., 50 ohms 12/9
250 mA., 3 H., 50 ohms 8/9
150 mA., 10 H., 50 ohms 10/11
150 mA., 6-10 H., 150 ohms, Tropicalised 6/9
100 mA., 10 H., 100 ohms, Parmeko 6/9
100 mA., 5 H., 100 ohms, Tropicalised 3/11
50 mA., 50 H., 1,000 ohms 6/9
L.T. type 1 amp., 2 ohms 2/9

SPECIAL OFFERS. Small 2 gang variables .0005 mfd., 4/9. 8-8 mfd., 450 v. Electrolytics (midget) in lots of six, 1/6 ea.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1 An all dry battery eliminator. Size 5½ × 4½ × 2in. approx. **Completely replaces batteries supplying 1.4 v. and 90 v. where A.C. mains 200-250 v. 50 c/s. is available. Suitable for all battery portable receivers requiring 1.4 v. and 90 v.** This includes latest low consumption types. Complete kit with diagrams 39/9, or ready for use. 46/9.

Type BM2. Size 8 × 5½ × 2½in. Supplies 120 v., 90 v. and 60 v., 40 mA. and 2 v. 0.4 a. to 1 amp. fully smoothed. **THEREBY COMPLETELY REPLACING BOTH H.T. BATTERIES AND L.T. 2v. ACCUMULATORS.** When connected to A.C. mains supply 200-250 v. 50 c/s. **SUITABLE FOR ALL BATTERY RECEIVERS** normally using 2 v. accumulator. Complete kit with diagrams and instructions 49/9 or ready for use 59/6.

PLESSEY DUAL CONCENTRIC 12in. P.M. SPEAKERS. (15 ohms), consisting of a high quality 12in. speaker, of orthodox design supporting a small elliptical speaker ready wired with choke and condensers to act as tweeter. This high fidelity unit is highly recommended for use with our A8 or any similar amplifier. Rating is 10 watts. Price only £5/17/6.

MAINS ENERGISED SPEAKERS R.A. 2-3 ohms. 8in Field 600 ohms., 10/9. 10in. Field 1,500 ohms., 23/9.

R.S.C. TRANSFORMERS

FULLY GUARANTEED, INTERLEAVED AND IMPREGNATED

MAINS TRANSFORMERS
Primaries 200-230-250 v. 50 c/s.

FULLY SHROUDED UPRIGHT MOUNTING
250-0-250 v. 60 mA. 6.3 v. 2 a., 5 v. 2 a., Midget type, 2½-3-3in. 17/6
350-0-350 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a. 19/9
250-0-250 v. 100 mA., 6.3 v.-4 v. 4 a., c.t., 0-4-5 v. 3 a. 25/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a. 23/9
250-0-250 v. 100 mA., 6.3 v. 6 a., 5 v. 3 a., for R1355 conversion 31/-
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a. 23/9
300-0-300 v. 100 mA., 6.3 v. 4 v. 4 a., c.t., 0-4-5 v 3 a. 26/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a. 23/9
300-0-300 v. 130 mA., 6.3 v. 4 a., c.t., 6.3 v. 1 a., suitable for Mullard 510 Amplifier 33/9
350-0-350 v. 100 mA., 6.3 v.-4 v., 4 a., c.t., 0-4-5 v. 3 a. 26/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a. 33/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a. 33/9
425-0-425 v. 200 mA., 6.3 v. 4 a., c.t., 6.3 v. 4 a. c.t., 5 v. 3 a., suitable Williamson Amplifier, etc. 49/9
450-0-450 v. 250 mA., 6.3 v. 6 a., 6.3 v. 6 a., 5 v. 3 a. 69/6

TOP SHROUDED DROP-THROUGH TYPE
250-0-250 v. 70 mA. 6.3 v. 2.5 a. 13/9
260-0-260 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a. 16/9
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a. 18/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a. 22/9
300-0-300 v. 100 mA., 6.3 v.-4 v. 4 a., c.t., 0-4-5 v. 3 a. 23/9
350-0-350 v. 100 mA., 6.3 v. 4 a. c.t., 5 v. 3 a. 22/9
350-0-350 v. 100 mA., 6.3 v.-4 v. 4 a. c.t., 0-4-5 v. 3 a. 23/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a. 29/9

E.H.T. TRANSFORMERS, 2,500 v. 5 mA., 2-0 2 v. 1.1 a., 2-0-2 v. 1.1 a., for VCR97, VCR517 ..... 36/6

FILAMENT TRANSFORMERS
Primaries 200-250 v. 50 c/s.
6.3 v. 1.5 a... 5/9 — 0-2-4-5-6.3 v. 4 a. 16/9
6.3 v. 2 a. 7/6
0-4-6.3 v. 2 a. .... 7/9 — 6.3 v. 6 a. .. 17/6
6.3 v. 3 a. .... 8/11 — 12 v. 3 a. or 24 v. 1.5 a. .. 17/6
12 v. 1 a. 7/9

CHARGER TRANSFORMERS
All with 200-230-250 v. 50 c/s. Primaries: 0-9-15 v. 1½ a., 11/9; 0-9-15 v. 3 a., 16/9; 0-3.5-9-17 v. 3 a., 17/9; 0-3.5-9-17 v. 4 a., 18/9; 0-9-15 v. 5 a., 19/9; 0-9-15 v. 6 a., 23/9; 0-9-15 v. 7.5 a., 28/9.

ELIMINATOR TRANSFORMERS
Primaries 200-250 v. 50 c/s.
120 v. 40 mA., 5-0-5 v. 1 a. 14/9
90 v. 15 mA., 6-0-6 v., 250 mA. 9/11

OUTPUT TRANSFORMERS
Midget Battery Pentode 66:1 for 3S4, etc. 3/6
Small Pentode, 5,000Ω to 3Ω 3/9
Standard Pentode, 5,000Ω to 3Ω 4/9
Standard Pentode, 8,000Ω to 3Ω 4/9
Multi-ratio 40 mA. 30:1, 45:1, 60:1, 90:1, Class B Push-Pull 5/6
Push-Pull 8 Watts 6V6 to 3 ohms 8/9
Push-Pull 10-12 Watts 6V6 to 3Ω or 15Ω 15/9
Push-Pull 10-12 Watts to match 6V6 to 3-5-8 or 15Ω 16/9
Push-Pull 15-18 Watts, sectionally wound, 6L6, KT66, etc., to 3 or 15 ohms 21/9
Push-Pull 10-15 Watts, Ultra Linear, designed for Mullard Amplifier 510 .. 39/6
Push-Pull 20 Watt high-quality sectionally wound, 6L6, KT66, etc. to 3 or 15Ω 47/9
Williamson type exact to spec. 85/-

SMOOTHING CHOKES
250 mA., 5 H., 100 ohms. 11/9
150 mA., 7-10 H., 250 ohms. 11/9
100 mA., 10 H., 200 ohms. 8/9
80 mA., 10 H., 350 ohms. 5/6
60 mA., 10 H., 400 ohms. 4/11

R.S.C. A6 ULTRA LINEAR 30 WATT AMPLIFIER

NEW 1956 DESIGN. HIGH FIDELITY PUSH-PULL UNIT EMPLOYING SIX VALVES. Tone Control Pre-amp stages are incorporated. Sensitivity is extremely high Only 30 millivolts minimum input is required for full output. **THIS ENSURES THE SUITABILITY OF ANY TYPE OR MAKE OF MICROPHONE OR PICK-UP.** Separate Bass and Treble controls give both "lift" and "cut" with ample tone correction for long playing records. **AN OUTPUT SOCKET WITH PLUG IS INCLUDED FOR SUPPLY OF 300 v. 20 mA. and 6.3 v. 1.5 a. FOR A RADIO FEEDER UNIT.** Price in kit form with easy-to-follow wiring diagrams. **9 GNS.** Only Carr. 10/-. Or Factory built with 12 months' guarantee. 50/- extra. **TERMS ON ASSEMBLED UNITS: DEPOSIT 3 gns. and 9 monthly payments of 23/6.** If required an extra input with associated vol. control can be provided so that two separate inputs such as "mike" and gram., etc., etc., can be simultaneously applied for mixing purposes. Extra cost of this 13/-. Cover as illustrated 17/6 extra.

Type 807 output valves are used with High Quality Sectionally wound output transformer specially designed for Ultra Linear operation. Negative feedback of 17 D.B. in main loop. **CERTIFIED PERFORMANCE FIGURES ARE EQUAL TO MOST EXPENSIVE UNITS AVAILABLE.** Frequency response ± 3 D.B., 30-20,000 c/cs., 12 D.B. "lift" at 50 c/cs., 12 D.B. "lift" at 12,000 c/cs., Hum and noise 70 D.B. down. Good quality reliable components used. Chassis finish blue crackle. Overall size 12 × 9 × 9in. approx. Power consumption 150 watts. For A.C. mains 200-230-250 v. 50 c/cs. Outputs for 3 and 15 ohm speakers. **EQUALLY SUITABLE FOR THE CONNOISSEUR OR FOR LARGE HALLS, CLUBS, or OUTSIDE FUNCTIONS. IDEAL FOR USE WITH MUSICAL INSTRUMENTS SUCH AS STRING BASS, ELECTRONIC ORGAN, GUITAR, etc. FOR DANCE BANDS, GARRISON THEATRES, etc., etc.** We can supply Microphones, Speakers, Rotary Converters, etc., at keen cash prices or on H.P. terms with amplifiers.

EXPORT ENQUIRIES INVITED

R.S.C. TA1 HIGH QUALITY TAPE DECK AMPLIFIER

FOR ALL DECKS WITH HIGH IMPEDANCE RECORD/PLAYBACK AND ERASE HEADS. Such as Lane, Truvox, etc. Chassis size 12-7-3in. Overall size 12-7-6½in. For 230-250 v. 50 c/cs. A.C. mains. Output for standard 2-3 ohm speaker. Only 15 millivolts input required for full recording. Only 2 millivolts minimum input required from recording head. Magic Eye recording level indicator. Provision for feeding P.A. amplifier. Can be used as gram. amplifier with input of 0.75 v. R.M.S. Negative feedback equalisation. Linear frequency response ± 3 D.B. 50-11,000 c/cs. Facilities for recordings at 15in., 7½in. or 3¾in. per second. Automatic equalisation at the turn of a knob. When switching from record to playback position automatic demagnetisation of heads is assured. **PERFORMANCE IS COMPARABLE WITH UNITS AT OVER TWICE THE COST. LEAFLET 6d.** **11 GNS.** Ready for use Carr. 7/6

GARRARD 3-SPEED AUTOMATIC RECORD CHANGERS. Latest Model. Type RC110. Fitted high fidelity turnover crystal pick-up head. For 200-250 v. A.C. mains. Limited number. Brand new cartoned. Only **£8/17/6**, plus 5/6 carriage.

H.M.V. LONG PLAYING RECORD TURNTABLE COMPLETE WITH CRYSTAL PICK-UP (SAPPHIRE STYLUS). Speed 33⅓ r.p.m. BRAND NEW. CARTONED. Only **£3/19/6** (approx. half price). Carr. 5/- (for 200-250 v A.C. Mains).

MICROPHONES. High fidelity crystal types. Acos 33-1 hand or desk type, **50/-**. Piezzo with heavy floor base and telescopic stem, **£6/19/6**.

R.S.C. 4-5 WATT HIGH GAIN AMPLIFIER TYPE A5

A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high-fidelity pick-up heads in addition to all other types of pick-ups and practically all mikes. Separate Bass and Treble controls are provided. These give full long playing record equalisation. Hum level is negligible, being 71 D.B. down, 15 D.B. of negative feedback is used. H.T. of 300 v. 26 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit or Tape Deck pre-amplifier. For A.C. mains input of 200-230-250 v., 50 c/s. Output for 2-3 ohm speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with the blue hammer finish, and point-point wiring diagrams and instructions. Exceptional value at only **£4/15/-**, or assembled ready for use 25/- extra, plus 3/6 carriage.

R.S.C. A73-4 WATT QUALITY AMPLIFIER

A highly sensitive 4-valve amplifier using negative feedback and having an excellent frequency response. Pre-amplifier and Tone Control stages are incorporated with separate Bass and Treble controls giving full tone compensation for Long Playing records. Suitable for any kind of pick-up including latest high fidelity types. H.T. of 250 v. 20 mA. and L.T. 6.3 v. 1 a. available for supply of Radio Feeder Unit, etc. ONLY 40 millivolts input required for full output. Fully isolated chassis with baseplate. For A.C. mains 200-250 v. 50 cycles. Output for 2-3 ohm speaker. Complete kit of parts with point-to-point wiring diagrams and instructions. Only £3/15/-, carr. 3/6 or factory built 22/6 extra

BRAND NEW B.S.R. MONARCH 3-SPEED MIXER AUTO-CHANGERS. With crystal pick-up and dual point sapphire stylii for standard or long playing records. Plays ten 7in., 10in. or 12in. intermixed. For A.C. mains 200-250 v. 50 c/cs. Supplied in sealed cartons with template and operating instructions. **£7/15/-** plus 3/6 carr.

WALNUT VENEERED CABINETS. Designed for above record changers with provision for housing amplifier and speaker. Attractive design. Limited number. Brand new cartoned **£3/19/6**. carr. 7/6.

QUALITY AMPLIFIERS. 3-4 watt, specially designed for use with BSR changer and above cabinet. Latest miniature type valves used. Separate Bass and Treble Controls and Vol. Control with mains switch. For A.C. 200-250 v. mains. Ready for use, only **£3/19/6**. carr. 3/6.

P.M. SPEAKERS. Suitable for use with above equipment. Elliptical 7 × 4ins. with 2-3 ohms speech coil, **19/9** ea.

COLLARO HIGH FIDELITY MAGNETIC PICK-UPS. High impedance, brand new, boxed at fraction of normal price. Only **31/-**.

P.M. SPEAKERS. 2-3 ohm., 5in. Goodmans, **17/9**, 6½in. R.A., **15/9**. 8in. Rola, **19/9**. 10in. R.A., **26/9**. 12in. Plessey, **29/11**.

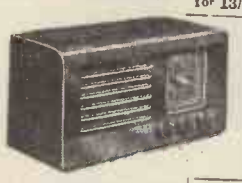
R.S.C. ULTRA LINEAR 12-WATT AMPLIFIER

NEW 1956 MODEL A8 HIGH-FIDELITY PUSH-PULL AMPLIFIER WITH "BUILT-IN" TONE CONTROL, PRE-AMP. STAGES.

High sensitivity. Includes 5 valves (807 outputs). High Quality sectionally wound output transformer, specially designed for Ultra Linear operation, and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut." Frequency response ± 3 db. 30-30,000 c/cs. Six negative feedback loops. Hum level 71 db. down. ONLY 70 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and practically all microphones. Comparable with the very best designs. For STANDARD or LONG PLAYING RECORDS. For MUSICAL INSTRUMENTS such as STRING BASS, GUITARS, etc. OUTPUT SOCKET with plug provides 300 v. 20 mA. and 6.3 v. 1.5 a. For supply of a RADIO FEEDER UNIT. TERMS ON ASSEMBLED UNITS with extra input as mentioned below, DEPOSIT £2/19/6 and nine monthly payments of £1. Size approx. 12-9-7in. For A.C. mains 200-230-250 v. 50 c/cs. Output for 3 and 15 ohm speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied.

Unapproachable value at **£7/15/-** or factory built 45/- extra. Carriage 10/-. If required louvred metal cover with 2 carrying handles can be supplied for 17/6. Where an extra input socket with associated volume control is required for mixing purposes this can be provided for 13/- extra.

THE SKY FOUR T.R.F. RECEIVER



A design of a 3-valve 200-250 v. A.C. Mains receiver with selenium rectifier. For inclusion in either of cabinets illustrated above. It employs valves 6K7, 6P61, 6P6G, and is specially designed for simplicity in wiring. Sensitivity and quality is well up to standard. Point-to-Point wiring diagrams, instructions and parts list, 1/9. This receiver can be built for a maximum of **£4/19/6** including cabinet. Available in brown or cream bakelite veneered walnut.

ROTARY CONVERTERS. 200 watts. Input 12 v. D.C. Output 230 v. 50 c/cs. A.C. Only 7 gns. Carr. 7/6.

FOUR-STAGE RADIO FEEDER UNIT

Design of a HIGH FIDELITY L. and M. wave T.R.F. Unit with self-contained heater supply and thorough H.T. decoupling. Only 250-400 v. 15-20 mA. H.T. required from main amplifier. Three valves and Low Distortion Germanium Diode Detector. Two variable Mu controlled H.F. stages, 3 gang condenser tuning. Switch position for Gram. and Gram. input and output sockets. Performance comparable with the best in Feeder Units. For A.C. mains 200-230-250 v. operation. Size 11-6-7½in. Illustrations full set or easy-to-follow wiring diagrams and instructions and individually priced parts list 2/6. This unit can be built for only £3/15/-, including Dial and Drive knobs and every item required.

SUPERHET FEEDER UNIT. Design of a High Quality Radio Feeder Unit suitable for use with any amplifier providing smoothed H.T. 250/300 v. 15 mA. and 6-3 v. 1 amp. L.T. Parts list, Instructions, Illustration, and point to point wiring diagrams 2/6. Total building cost £4/15/-.

DEFIANT RECORD PLAYING TURNTABLE COMPLETE WITH MAGNETIC PICK-UP. Pick-up is high impedance type. Unit is housed in a beautiful walnut veneered cabinet of attractive design. For all standard records (78 r.p.m.) Limited number. Brand new cartoned. £5/17/6 carr. 7/6.

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS HF1012, 10 watts, 15 ohm (or 3 ohm) speech coil. Where a really good quality speaker at a low price is required, we highly recommend this unit with an amazing performance **£4/10/9**. Please state whether 3 ohm. or 15 ohm. required.

Radio Supply Co. (LEEDS) LTD.

32 THE CALLS. — LEEDS, 2.

Terms C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/9 extra on *all* orders under £2, 2/9 extra under £5 unless carriage charge stated. Full Price List 6d. Trade List 5d. Open to Callers: 9 a.m. to 5.30 p.m. Saturday until 1 p.m.

There is always a fine selection of equipment at

A.P.Q.9 RADAR JAMMING UNIT

Containing 913A Photo Multiplier Cell, complete with resistance network and lightproof box. Wide band amplifier (2) 6AC7 and 6AG7, driving a pair of parallel 807s which Grid modulate a pair of 8012s in push-pull. Lecher lines, these cooled by blower motor. Cathode loaded by Co-axial stubs which simultaneously guillotine tune anode and grid lines with a counter mechanism. Output is matched to aerial by a matching stub. Suitable for use in centimetric bands.

Brand new. Price £5, plus 10/- packing and carriage.

RECEIVER UNIT Ex 1143A

Suitable for conversion to 2 metres or F.M. Wrotham transmissions.

Valve line-up: (4) EF50. (1) EL32, (2)EF39 (1) EBC33. (1) EA50. Supplied with circuit diagrams.
Fully valved 35/- each, plus 3/- p.p.

ABSORPTION WAVEMETER

Easily converted to 2 metres or 70 cm. In Copper-Plated metal case 3½ × 4½in. × 5½in. with dial calibrated 0-100 and 80 V Neon Tube. Coverage approx. 190-210 Mc/s. New, 6/6 each, post paid.

THROAT MICROPHONES

Type T30. U.S. Manufacture.

Complete with elastic strap. Lead terminating at 2-pin plug PL.291, and socket JJ-048. New and boxed, 3/- each, post paid.

VIBRATOR PACKS (Mallory)

12V Input 150V 40 mA Size 5¼in. × 5¼in. × 3in.	Price 17/6 each.
12V Input 275V 80 mA Size 5½in. × 5½in. × 3in.	Price 25/- each.
6V Input 275V 80 mA Size 4½in. × 6in. × 4½in.	Price 35/- each.
With harness.	Plus 2/6 p.p.

LINE TESTING METER UNIT

With one 0-30 mA and one 0-100V 2½in. Panel Mtg. Meters, P.O. Switch, 3 Panel Mounting. Fuse Holders in strong polished wooden case with lined lid and handle. Size 8in. wide × 5¾in. × 5¾in. Price 15/- each. Plus 2/6 p.p.

COMMAND RECEIVERS

BC453B 190-500 Kc/s. Price £2/17/6 each.
BC454B 3-6 Mc/s. Price £1/5/- each.
BC455B 6-9.1 Mc/s. Price £1/5/- each.
Fully Valved—Less Dynamotors (Not New). Plus 3/- p.p.

COMMAND TRANSMITTERS

BC—458—A 5.3-7 Mc/s., BC—459—A 7-9.1 Mc/s. Price £2 each.
Fully Valved—Less Dynamotors (Not New). Plus 3/- p.p.

A.R.88. Ceramic Wafered Range Switch Assembly. 8 wafers mounted on chassis measuring 9in. × 9in. × 3¼in. Spindle length 15in. Price 17/6. Plus 2/- p.p.

3 c/m WAVEGUIDE

(American) New Flexible and Rigid in lengths from 18in. to 5ft. Also hard bend, easy bend and fittings. ***Send for prices and details.***

PAPER BLOCK CONDENSERS

8 μF 600 V wkg., 5/6 p.p. 4 μF 400 V wkg., 4/- p.p.

P.O. TYPE MAGNETIC COUNTERS

500 ohm reading 0 to 9999. Size 5in. long × 1½in. × 1¼in. Price 5/6 p.p.

AMPLIFIER CHASSIS

5in. × 3in. × 1½in. with three ceramic international octal valveholder plus a quantity of components, 2/6 p.p.

BENDIX I.F. Transformers. 1.63 Mc/s complete in cans, set of two new and boxed. Size 2 × 1½ × 3¾in., 5/- p.p. 1/6.

BENDIX Potted Audio Output Transformer complete with integral smoothing choke. Ratings 4½ watt 9,000 ohm Primary. 600 and 4,000 ohm Secondary. Size: 4 × 1¾ × 2in. New and boxed, 4/6, p.p. 1/6.

INSULATION TAPE

Perfect condition. ½in. wide, 25 yd. reels, foiled, in tins, 1/3 each, p.p. 8d.

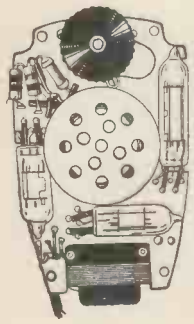
ELECTRO MAGNETIC MICROPHONES

With switch and plug R.A.F. Type 48, new and boxed, 2/- each, p.p.

R.C.A. CROSSOVER NETWORKS

15 ohms 800 cycles, complete with chokes and condensers mounted on chassis measuring 7in. × 12in. Price 18/6 plus 3/6 p.p.

Make a miniature POCKET RADIO



Incorporating high "Q" technique using the New Ferrite rod. Made possible by simple conversion of an ex-Govt. Hearing Aid.

Technical Details. A Germanium Diode Detector circuit followed by the existing 3 valve Amplifier, giving adequate amplification throughout the medium wave band.

This conversion can be carried out in approximately 30 minutes.

SEE and HEAR this Miniature POCKET RADIO demonstrated.

THE COMPLETE KIT OF PARTS includes a Type OL10 Hearing Aid (with Crystal microphone) in perfect working order with miniature ear phone and moulded ear insert attached; ferrite rod, germanium diode, components, circuit diagram and full instructions.

PRICE **£2 6s. 0d.** Post paid

ALL COMPONENTS SOLD SEPARATELY

Deaf Aid Unit with earpiece..	£1	15	0
Plastic Ear mould		2	0
Ferrite Rod		5	0
Conversion Components		4	0
Batteries 1.5v L T (Type D 18)			8
30 v H T (Type B 119)		4	3

NOTE: As the crystal microphone is not used in the Pocket Radio, it can, if desired, be used as a general microphone and it does not require a matching transformer.

All these fine offers are on display at ➔

PROOPS BROS. LTD. — *The Walk-around Shop*

BEACON

TRANSMITTER RECEIVER AN/PPN-2

comprising Transmitter Receiver RT-37/PPN2 complete with Valves, Antenna System (9'6" High, collapsible) Head Set HS/30 miniature light weight type, complete with cord. Canvas carrying case with shoulder harness. Instruction manual and circuit.

- **Frequency** 214-234 Mc/s in 5 channels.
- **Valve line-up:** Receiver:— IR5, 3A5, 3 of 1S5. Transmitter 4 of 3A5.
- **Power Output** 8 watts.
- **Power Supply** operated from a 2 v. battery. H.T. obtained through 2 synchronous vibrator packs built in TX/RX.

Size: 14½in. high, 13in. wide, 9¼in. deep.

NEW and in Original Packing complete with valves.

PRICE **£5 10s. 0d.** *Plus 10/- crg.*

AN/APN.1 TRANSDUCER

This Unit consists of Magnet, and Coil which is attached to an aluminium diaphragm suspended freely and perforated to prevent air damping. Mounted on a Ceramic cover which sits over the diaphragm is a form of 2-Gang capacitor which has a swing from 10-50 pF.

The above unit is used as part of Wobbulator described on page 252 of the June "Wireless World." PRICE 7/6 p.p.

AN/APN.1 A.F. AMPLIFIER

An Audio Frequency Amplifier in a sub-chassis 5 × 3 × 3¼in. R×C coupled, using TWO 12SH7 and ONE 12SJ7 valves; and can be used for Telephone Intercomm., Pre-Amplifiers, etc.

Price, post paid **15/-**

MINIATURE I.F. STRIPS

Size 10¾ × 12¼ × 3in. Frequency 9.72 Mc/s. 2 EF.92s and 1 EF.91 I.F. amps. EB.91. DET/AGC. EF.91 AGC. Amp. and EF.91. Limiter. Circuit supplied.

Price **8/-** less valves Post paid.

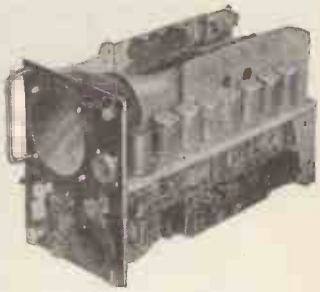
MAINS POWER UNIT

TYPE 234

(For use with Receiver R 1392)

Double Smoothed 200-250 v. 50c Input. 240 V. 100 mA. 6.3 at 6 amps. with Volt Meter reading input and output voltages. Size: 19in. × 10in. × 6½in. Standard Rack Mounting. Price £4/10/0 each, plus 7/6 carriage.

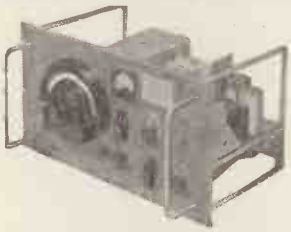
TYPE 62A INDICATORS



Ideal for conversion to oscilloscopes, T.V. units, etc. Containing V.C.R.97, 12 VR.91 (EF.50), 2 VR.54 (EB.34), 3 VR.92 (EA.50), 4 CV.118 (SP.61). Slow-motion dial, 13 Pots and scores of useful components. Size 8½ × 11½ × 18in. In wooden packing case, £3, carriage 7/6.

RECEIVER TYPE R 1132

Frequency 100-126 Mc/s. 11-valve Superhet.



Valve line-up: R.F. Amplifier VR.65 (SP.61); Frequency changer VR.65 (SP.61); Local Oscillator VR.66 (P.61); Stabilizer VS.70 (7455).

3 × I.F. Amplifiers VR.53 (EF.39); B.F.O. VR.53 (EF.39); Detector VR.54 (EB.34); A.F. Amplifier VR.57 (EK.32); Output VR.67 (6J5).

Switchable A.G.C. and A.V.C. Variable B.F.O.

Circuit diagrams with units. Easily converted to cover Wrotham Band. No alterations to wiring required. Conversion Slugs and instructions, supplied free. Size 19 × 10 × 10in. Standard Rack Mounting.

PRICE **£3/7/6.** Packing and carriage 15/-. 10/- returnable on Packing Case.

I.F. AMPLIFIER UNIT *(as illustrated)*

460 Kc/s with IT4 Brand New and Boxed. Fully Screened in plug-in Box. Size 2½in. × 1in. × 4½in. Price, with circuit, 10/- ea., plus 1/- p.p.

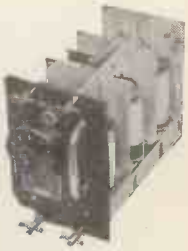
MINIATURE TRANSMITTER STRIP

TYPE 81. Complete with valves CV.415 (TT15), CV.309 (QV04-7), 2-6AM6, 2-EL.91 and Crystal. Circuit supplied Free with unit. Price £4/10/-, post paid.

POWER UNIT Type 173

12 or 24 volt D.C. Input 120V, 60 mA. Output. Containing Vibrator Transformer, 12 Volt Vibrator, two 120 Volt Selenium Rectifiers, Chokes and Condensers. Size 10½in. × 6in. × 3in. Price 12/6, post paid.

R.F. UNITS



R.P.25 40-50 Mc/s. Switched Tuning. Valved. 9/6 each.

R.F.26 50-65 Mc/s. Variable Tuning. Valved (new and boxed) 25/- each.

Packing and postage 2/- each.

NOTE: Carriage prices quoted apply only to England and Wales.

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CLYNE RADIO LTD.

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MUSeum 5929/0095.
(50 yards only from Tottenham Court Road Tube !)
All post orders please to:—24-26, HAMPSTEAD RD., LONDON, N.W.1
EUSton 5533/4/5

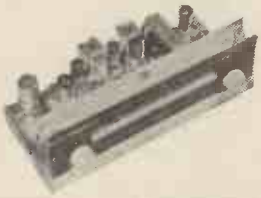
TELETRON BAND III CONVERTOR ! Still available, this very popular convertor kit as illustrated and fully described in previous issues of the "W.W." For use with most T.R.F. or Superhet Band I T.V. Receivers. Construction details only, with separate individually priced parts list 6d. post free. Kit complete as specified 48/6, plus 2/- P. & P.
Mk. II Fringe area version kit complete 59/6, plus 2/- P. and P. Power pack kit for either of above 25/-.
We carry comprehensive stocks of all Band III Convertors by leading manufacturers. Also aerials, cross-over boxes, air-spaced low-loss co-axial cable at 10d. per yard. Let us have your enquiries. Any branded convertor supplied on H.P. terms !

THE JASON F.M. TUNER

Based on the booklet by Data Publications Ltd., 2/- post free, including our individually priced Parts List. Highly sensitive, free from drift. Incorporates 4 valves 6AM6 and 2 specially graded G.E.C. Crystals. The kit supplied includes drilled chassis with tuning condenser, scale calibrated in mc/s., and attractive bronze stove-enamelled front plate already mounted (illustrated). Front plate size 8in. × 5in., chassis 7in. × 4½in. × 1½in. Complete standard kit £6/15/- plus 2/6 P. & P. Fringe area kit £7/15/-, plus P. & P.

THE T.S.L. F.M. TUNER !

We can now supply this FM/VHF adaptor either in kit form, or fully assembled, wired and tested. Our price for the ready-built unit which incorporates its own power supply, is £13/15/- only tax paid, plus 5/- P. & P. or H.P. terms. Magic eye tuning indicator, just plug in, 19/- extra. Or the kit complete as specified £10/19/6 plus 3/6 P. & P. The booklet "F.M. TUNER CONSTRUCTION" (32 pages) with full technical data and point-to-point wiring diagrams, together with our separately priced parts list, is available at 2/6 post free.



THE T.S.L. AM/FM CHASSIS !
Exceptional value. Covers L.M. and S.W. plus F.M.! 8-valve push-pull output. Ferrite rod aerial. Valve line-up: ECC85, ECH81, EF89, EABC80, ECC82, two 6BW6s plus 5Y3. Large full-vision dial, size 14¾ × 6in. Chassis size, overall: 15 × 7½ × 8in. high. Tax paid 26 guineas, plus 5/- packing and carriage. A supplementary extra is magic eye EM34, complete with escutcheon and fixing cable at 26/-. H.P. terms available. Demonstrations at 18 Tottenham Court Road !

THE DULCI F.M. TUNER. Incorporates own power supply, suitable for use with any amplifier. Valve line-up: ECC85, two EF89, EABC80, 6 × 4, and EM80 indicator! Overall size: 9 × 6 × 5½in. high. Pre-Budget price £16/16/- plus 5/-. P.P. Illustrated leaflet available, also H.P. terms.

SPECIAL OFFER ! ! Champion Model 835 FM/VHF Adaptor! Designed for the instant conversion of A.C. radiograms, table A.M. receivers and Hi-Fi audio amplifiers, to enable owners through their existing equipment to obtain the best results from the new F.M. transmission. Two connections only. One to the A.C. mains supply, the other to the pick-up sockets. Valve line-up: EF85, two EF80s, EB91, and EZ80. In attractive red and cream bakelite cabinet. Illustrated leaflet available on request. Price whilst stocks last only £13/19/6 tax paid, plus 3/6 P. & P. H.P. terms available.

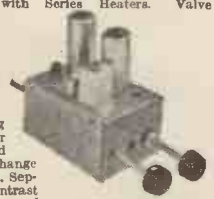
DENCO F.M. TUNER. This highly successful kit is still available at inclusive price of £6/7/6 plus 2/6 P. & P. This kit includes all components and the five valves required for the extra I.F. Stage for fringe area reception. If required, "Denco" dial and drive assembly is available for the above at 9/- extra. Full constructional details 1/6 post free.

F.M. POWER PACK KIT. We can now supply complete kit for power pack suitable for the above F.M. tuners or any other similar type. Price for the complete kit is 37/6 only, or 52/6 for ready assembled unit. This pack is extremely small, incorporating valve rectifier type 6X4 and built on chassis size only 6 × 4 × 1½in. Optional extra for power pack. Bulgin Octal Plug 2/3.

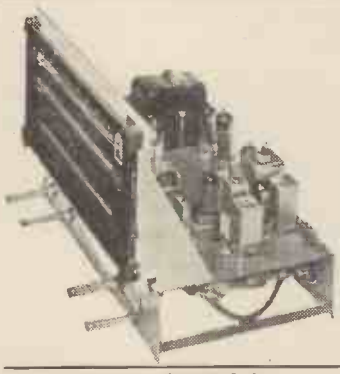
THE R.E.P. 1-VALVE RECEIVER. All dry battery operation, for use with headphones. The complete kit is available at 42/-, less batteries, plus 2/- P. & P., or full instructions at 9d. post free.

COMPETITIVE ! ! BAND III. CONVERTORS !

THE FAMOUS UNIVERTER—COMPARE THE PRICE
Handsome walnut cabinet. Suitable all areas. Contains own power supply. Simply connect to aerial. Four-valve circuit. Complete with all instructions £6/19/6 plus 3/6 P. & P.



Type "M.L." for running from existing power supplies or separate power pack. Available with Series Heaters. Valve line-up: PCC84 and PCF80. Size: 4 × 2¾ × 4½in. Fitted with external fine tuning control for Band 3 and Band 1/3 change over switch. Separate contrast control for Band 3. Power requirements: H.T. 150/250 v. at 30 mA., L.T. 15/16 v. 3 amp. (Series Heaters). Unit simply fitted inside cabinet. Complete with handsome escutcheon. Available for A.C. operation with parallel heaters, ECC84 and ECF80 as above. Price £4/12/6. P. & P. 2/6. Full instructions supplied with each unit. Please specify whether for London, or Birmingham, or Manchester.



AM/FM RADIOGRAM CHASSIS ! BARGAIN !

A special purchase of strictly limited quantity enables us to offer the following! For Medium, Long and F.M. Wavebands, plus gram position . . . Chassis size overall 13½in. long, 9in. high, 7½in. deep. Dial which is attractive red, green and gold lettering, on black background, measures 12in. × 5½in. horizontal. For A.C. mains, 200/250 v. Valve line-up EL84, EABC80, EF85, ECH81, ECC85, EZ80, plus EM80 Magic Eye!! Limited quantity at bargain price of £18/19/6 only, plus 5/-. P. & P. H.P. terms.

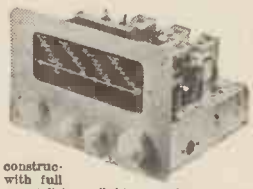
DULCI AM/FM CHASSIS H4

Illustrated leaflet available. L.M. and Short Waves plus F.M. This is a quality chassis 6 latest B.V.A. Mullard Valves, including magic eye. High Q. inductances throughout, also Ferrite rods. Price is £27/16/- cash—or H.P. terms.

DULCI AM FM TUNER

Just released. Details available. Price £23/12/7 including tax, or H.P. terms.

AM/FM KIT ! FIRST AGAIN !



Introducing the JASON AM/FM KIT for medium waves and F.M.!
As illustrated this is a very high quality chassis incorporating 8 of the latest miniature valves, plus DM70 magic eye. Kits are available for chassis complete with output stage at £15/5/-. Also less output stage but with own built-in power pack at £13/19/6 only. These are high fidelity units and exceptional value at these prices which include all required components and full constructional details. Fully illustrated Data Booklet with full construction details, plus individually priced component list, available per return of post at 2/- post free. Both plus 3/6 P. & P.

SPECIAL PURCHASE ! MANUFACTURER'S SURPLUS

Owing to favourable purchase, we can offer strictly limited quantity of these handsome chassis. AC/DC 200/250 v. for Medium and Long Waves, plus gram position. Incorporates own frame aerial. Valve line-up: U107, N108, DH107, W107 and X109. Overall chassis size 12 × 5¾ × 7½in. high. Attractive bronze dial with gold and cream lettering. Dial size 11½ × 4½in. Scale length 7½in. Logging scale provided. Price £7/19/6 only, tax paid, plus 3/6 P. & P. H.P. terms. £4 deposit plus four monthly payments of 22/-.

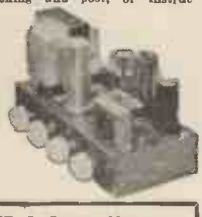
THE R.C. GRAM REPLACEMENT CHASSIS KIT.

Still available. Our very popular Gram Chassis replacement kit. For long, medium and short waves, and provision for gram. Valves 6K8. 6K7. 6Q7. 6V6 and 6X5.

For A.C. Mains 200/250 v. Chassis size: 13½in. × 5½in. × 2½in. Dial size 10in. × 4½in. Assembly is simplified by use of ready assembled coil pack. Illustrated booklet with full assembly instructions, with itemised price list, is 1/6 post free—or the kit complete to last nut and bolt at £8/8/- plus 2/6 P. & P.

THE R.C.3/4 WATT AMPLIFIER KIT.

Just released ! Compare the advantages ! Treble bass, AND middle controls ! For crystal or magnetic pickup ! A.C. Mains 200/250 v. Valve line-up. 6V6GT, 6SG7, metal 6X5GT. Negative feedback. Built on stove enamelled steel chassis, measuring only 8in. × 4in. × 1½in. Four engraved cream knobs are included in the price of the complete kit with all necessary practical and theoretical diagrams, at £4/5/- only, plus 2/6 packing and post, or Instruction Book, fully illustrated, for 1/-. Post free ! This amplifier can be supplied assembled, tested, and ready for use at £5/5/- plus P. and P. Hearing is believing.



ACOS TYPE 7 Crystal Microphone Inserts. Brand new, 7/6 each, post free.

Our advantageous H.P. terms are available on any single item over £5. Let us have your enquiries.

Please add postage under £1, or Cash with order. C.O.D charge extra—open 9 a.m to 6 p.m. Monday to Friday. Sorry but we close 1 p.m. on Saturday

THE "ECONOMY FOUR" T.R.F. KIT. A three-valve plus metal rectifier receiver. A.C. mains 200/250 v. Medium and Long waves. We can supply all required components right down to the last nut and bolt. Valve line-up 6K7, 6J7 and 6V6. Chassis ready drilled—Cabinet size 12in. long by 6in. high by 5in. deep—Choice of ivory or brown Bakelite, or wooden walnut finish cabinet. Complete instruction booklet with practical and theoretical diagrams. Each component brand new and tested prior to packing. Our price **£5/10/-** complete—Remember this set is being demonstrated at our shop premises! We proudly claim that our fully illustrated instruction booklet is the most comprehensive available for this type of receiver—Booklet available at 1/6 post free. This is allowed if kit is purchased later. Plus 2/6 packing and carriage for complete kit.

THE "SUPERIOR" FOUR KIT. Our new four-valve receiver. A.C. mains, 200/250 v. M. and Long waves. As with our very successful "Economy Four" all required components as supplied. Valve line-up: 2 6SG7, 6 X5GT and 6 V6GT. Chassis ready drilled. Cabinet size, 10½in. × 10in. wide. Maximum depth at base 5in. tapering to 3½in. at top. Sloping front. Very attractively finished in light walnut and peach. Each component brand new and tested prior to packing. Complete instruction booklet with practial and theoretical diagrams is provided. Booklet available at 1/6 post free. Our price for complete kit, **£6/9/6!** Please add 2/6 packing and carriage. If preferred, we can supply Cabinet Assembly only, comprising Cabinet and bracket wave-change switch, dial, pointer, drum pulleys, drive spindle, drive spring and knobs, at 45/-, plus 2/6 packing and carriage. N.B.—Our kits are even supplied with sufficient solder for the job.

N.B. All our T.R.F. Kit circuits now include specially wound Denco "Maxi-Q" coils on polystyrene formers, improved performance! Price remains the same.

SURPLUS BARGAINS

METERS

F.S.D.	Size	Type	Fitting	Price
50 microamps	D.C. 2in.	M.C.	R.P.	50/-
50 microamp	D.C. 5in.	M.C.	Rectangular	120/-
50 microamp	D.C. 4in.	M.C.	Rectangular	110/-
50 microamp	D.C. 3½in.	M.C.	F.R.	95/-
100 microamp	D.C. 2½in.	M.C.	F.R.	45/-
200 microamp	D.C. 2in.	M.C.	F.R. (Tropicalised)	30/-
200 microamp	D.C. 3½in.	M.C.	F.R.	65/-
500 microamp	D.C. 2in.	M.C.	F.R.	18/6
1 mA.	D.C. 2in.	M.C.	F.R.	17/6
1 mA.	D.C. 2in.	M.C.	F. Sq.	22/2
1 mA.	D.C. 2in.	M.C.	F. Sq. (1954 manufacture by Elliott)	25/-
1 mA.	D.C. 2½in.	M.C.	Desk Type	30/-
50 mA.	D.C. 9in.	M.C.	F. Sq.	8/6
500 mA.	D.C. 2½in.	M.C.	F.R.	10/6
.5 amp.	R.F. 2in.	Thermo	F. Sq.	6/6
1 amp.	R.F. 2½in.	M.C.	F.R.	10/-
120-0-120 amp	D.C. 2in.	M.C.	F. Sq. (shunt required)	15/-
150 amp.	A.C. 4in.	M.I.	R.P.	45/-
1 amp.	R.F. 2½in.	Thermo	R.P.	7/6
3 amp.	R.F. 2in.	Thermo	F. Sq.	6/-
20 amp.	D.C. 2in.	—	R.P. (with shunt)	10/6
25 amp.	D.C. 2½in.	M.I.	F.R.	6/6
30 amp.	D.C. 2½in.	M.I.	F.R.	12/6
15 volt	A.C. 2½in.	M.I.	F.R.	10/-
15-0-15 volt	D.C. 2½in.	M.C.	F.R.	17/6
300 volt	A.C. 2½in.	M.C.	F.R.	35/-
300 volt	A.C. 3½in.	M.I.	F.R.	30/-

SPECIAL. U.S. 0-1 mA. 2½in. taken from equipment but perfect, 22/6 each. R.P. = Round Projection. M.C. = Moving Coil. Thermo = Thermo-coupled. F. Sq. = Flush Square. F.R. = Flush Round. M.I. = Moving Iron.

METER RECTIFIERS. 1 mA. by G.E.C., at 6/6, also 5 mA. by G.E.C., at 6/6.

6-VOLT VIBRATOR PACK. Ex-W.D. 6-volt input, output 140 v. 30 mA. Fully smoothed and rectified, incorporating Wearite 6 volt 4 pin vibrator type NSB6. Unit size only 6½in. × 5in. × 2½in. Price **15/-** plus 1/-. P. & P. New condition.

COMMUNICATION RECEIVER PCR.2 3-wave band, 13-50, 190-570, 900-2,000 metres. Valve line-up 6V6, EBC33, X61 and 3-EF.39. Illuminated calibrated dial, fly-wheel tuning, aerial trimmer. In black crackle case size 17½in. × 10in. × 8in. Output socket for 3 ohm speaker, or headphones. Absolutely brand new in original cartons, manufactured for Govt. by PYE LTD.
Price **£7/10/-** only, plus p. and p. 10/-. With each set we supply full conversion details for A.C. mains. All required components for conversion available at 32/6 post paid. Limited quantity.
We can now supply already converted ready for A.C. Mains at **£9/19/6**, plus carriage. H.P. available.

METER SPECIAL. We have a limited quantity of aircraft electrical thermometers, Brand new, by Weston, 2in. moving coil meter, flush square fitting. These meters have a luminous scale graduated 40-140 degrees centigrade, but the full scale deflection is approximately 150 microamps! Price **12/6 each only**, plus 1/- P. & P.

VIBRATOR PACK. Brand new, by Mallory 12 volt input, 150 v. 40 mA. output. Complete with synchronous vibrator. **17/6**

COIL PACKS. Manufacturers' Surplus, Miniature size, only 2½in. × 2½in. × 1½in. deep. Iron-cored. For L.M. and S.W. with gram. position. Switch has 2-inch spindle. Absolutely brand new, complete with circuit. Price only **27/6**, plus 1/6 P. & P. A snip!

HEAVY DUTY CONSTANT VOLTAGE TRANSFORMER. Input: Variable from 110 to 250 volts. OUTPUT: 110 and 230 v. at 1.2 kVA. Contained in grey metal case with carrying handle. Overall size: 10in. w. × 8in. D. × 12in. H. Weight 1 qtr. 19lb. Brand new! **£8/10/-** plus 7/6 carr. & p.

No. 38 TRANSMITTER/RECEIVER WALKIE-TALKIE. Range approx. 5 miles. Coverage 7.4-9 Mc/s. The set only complete with valves at 25/-, in very good condition.

We also have available "38" sets absolutely complete with junction box, aerial, headphones, microphone, spare set of valves, with full operating instructions, absolutely brand new in original sealed packing cases, at 99/6 each complete station, plus 5/- carriage. Export enquiries invited.

STOP PRESS!! JUST ARRIVED!! Special "Quality" 7-valve Radiogram Chassis (Push-Pull Output) 3-waveband: Valve line-up X79, W77, 2/DK77, 2/DY86, UU8. £11/19/6 only. Plus 8/- p. & p. Further details on application.

THE R.C. RAMBLER ALL-DRY PORTABLE KIT

Full assembly details with practical and theoretical diagrams can be supplied at 1/6 post free. This is a truly professional 4-valve superhet—all dry—for medium and long waves. A cream plastic top panel, with dial engraved in red and green adds to the very imposing appearance of this model which is housed in an attractive cream and grey leatherette covered attache-case type cabinet: measuring only 9in. × 7in. × 5½in. Weight less batteries 4½lb., with batteries 6½lb. This set really has everything. Built-in frame aerial, high quality, extremely sensitive, and very adequate volume from the 5in. speaker. Valve line-up 3V4, 1R5, 1S5, 1T4. Also the required components, exactly as specified, including cabinet, can be supplied from stock at the special inclusive price of £7/7/- plus 2/6 p. and p. (less batteries). Uses Ever-Ready 90 v. H.T. type B126 at 10/-. Also LT 1.5 v. A.D. 35 at 1/6.

RAMBLER MAINS UNIT! At last we are able to offer our special mains units kit for using our popular all-dry "Rambler" on A.C. Mains. Complete kit, which when assembled fits snugly into battery compartment, can be supplied at 47/6, plus 1/6 packing and postage. Price includes all required components, and full assembly instructions. N.B.—This unit is completely self-contained in a metal box measuring 7in. × 2½in. × 1½in. and is ideally suitable for ANY all-dry battery portable requiring 90 v. H.T. and 1.5 L.T.

B.S.R. MONARCH. The very latest cream 3-speed mixer Auto-changer. Complete with turn-over crystal pick-up. Complete in original manufacturer's cartons, fully guaranteed. Price only **£7/19/6**, carriage paid. Buy now! Quantity at this price strictly limited.

JUST ARRIVED! Replacement pick-up cartridge for B.S.R. Monarch, etc., type HGP 37. Complete with sapphire styli, fitted in few seconds. Limited quantity at 18/6 only! Tax paid, post free!

RC.54. Special Purchase! Latest type 3-speed, incorporating "T" type turnover head. Cream finish. Original manufacturers cartons. £9/19/6 only, plus 3/6 p. and p. H.P. terms available.

GARRARD RC.110!!! 3-speed mixer auto-changer unit with G.C.2 t/o crystal head. Cream and brown finish. Brand new in sealed manufacturer's cartons with fitting and operating instructions. **£8/19/6** plus 5/- p. & p.

RECORD PLAYER CABINETS—to suit all types of single record and auto-changer units. Priced from 45/-. Send stamp for fully illustrated list.

R.F. UNITS. All new condition and complete. Case size 9½in. × 7½in. × 5in. Type 25. 40-50 Mc/s. 10/6. Switched Tuning. Type 26. 50-65 Mc/s. Variable Tuning. 22/6. ALL these units Post Free.

EX-W.D. CATHODE RAY TUBES. Guaranteed full picture. VCR97 at 40/-. VCR517C at 35/-. Also VCR139A—ideal for oscilloscope 2½in. screen at 35/-. We also have VCR97 with slight cut-off very suitable for oscilloscope, testing purposes, etc., at 15/- only. All these tubes are brand new, in original packing, and tested before despatch. Please add 2/6 packing and carriage for any of the above tubes.

MU-METAL SCREEN for VCR97. Price 10/-. post free.

MAINS TRANSFORMER BARGAINS. Limited quantities. Manufacturers' Surplus. 350-0-350, 80 mA., 6.3 v. 3 a., 5 v. 2 a. Half shrouded, drop-through, 14/6 only, plus 1/6 P. & P. 230 v. Input, 300-0-300 80 mA., 6.3 v., 3 a., 4 v. 2 a. Tropicalised drop-through type. 9/6 only, plus 1/6 P. & P. Input 110/230 v. Auto load 230 v. 750 mA., 350-0-350 130 mA. Tapped filament winding 6 v. 3 a., 15 v. 3 a., 21.5 v. .6 a., also 5 v. 2 a. Tropicalised drop-through type. 21/- plus 2/6 P. & P. 270-0-270, 100 mA. 6.3 v. 3 a., 5 v. 2 a., 200/250 v. Input universal mounting 16/6, plus 1/6 P. & P.

MAINS TRANSFORMER SPECIAL! Primary: 10-0-200-220-240 v. Secondary windings: 375-200-0-200-375 v. at 250 mA. Double wound 230 v. at 6 amp. 6.3 v. at 3 amp. 6.3 v. at 3 amp. 8 v. at 0.25 amp. Unshrouded, fully impregnated drop thro' type. 50/- plus 1/6 p.p.

RECEIVER TYPE 25/73. (The receiver section of TR1196). Supplied complete with full data for conversion to 3-wave-superhet receiver. Unit is complete with 6 valves 2-EF39, 2-EP36, FK32 and EBC33, also standard I.F.T.'s 465 Kc/s. Price 27/6 plus 2/6 P. & P.

TR1196 TRANSMITTER PORTION. We can also supply the transmitter portion of the above receiver incorporating valves, EL32, EF50, CV501. Type 600 relay transformer, coils, switches, etc. Limited quantity at 12/6 only, plus 2/6 P. & P.

HEADPHONES. Low resistance. Brand new Ex-W.D. type CLR. 7/6 per pair, plus 1/6 p. & p. High resistance, 4,000 ohms, brand new lightweight 15/- per pair, plus 1/6 p. & p.

VALVES

We have perhaps the most up-to-date valve stocks in the trade. A stamp will bring complete list but the following is a selection only of brand new imported valve types, fully guaranteed. Purchase tax paid.

EABC80	10/-	DAF96	10/6	PL83	11/6
EAF42	10/-	DF96	10/6	PY80	10/6
EB41	7/6	DK92	10/6	PY81	10/-
EB91	7/6	DK96	10/6	PY82	9/6
EBC41	10/-	DL96	10/6	PY83	11/6
EBF80	11/6	or 39/6 per set		UBC41	10/6
ECC81	9/-	of four		UCH42	11/6
ECC82	9/-	DM70	9/-	UF41	10/6
ECC83	9/-	EL41	10/6	UL41	10/6
ECC84	15/-	EL84	11/6	UY41	9/-
ECC85	10/-	EM80	9/-	6QA5	8/6
ECF82	15/-	EY51	12/-	6AT6	8/-
ECH42	11/6	EY86	14/6	6AU6	9/6
ECH81	11/6	EZ40	8/6	6BA6	8/6
ECL80	11/6	EZ80	8/6	6BE6	9/-
EF41	10/6	PCF80	12/6	6BW6	8/6
EF80	10/6	PCF82	12/6	6X4	7/6
EF85	10/6	PCC84	12/6	35W4	7/6
EF86	12/6	PL81	13/6	50B5	10/-
EF89	10/-	PL82	10/6	5Y3C5	10/-

In addition we naturally have all usual surplus types available such as 6V6GT, etc. All in our valve price list!

BRAND NEW C.R. TUBES.—By leading manufacturer, 12in. equivalent to MW 31/74 **£11/19/6.** MW36/24 Tinted. Latest type 14in. rectangular 6.3 v. heater. 12-14 Kv. in original sealed cartons. Limited quantity only at £12 19 6. Ditto 17in. type 17ASP4. Price £18/19/6. All H.P. available. Plus 15/- packing, carriage and insurance.

TRANSISTORS! MULLARD TYPE O.C71. Available ex stock at new list price of 24/- each, post free.

Another Cabinet Bargain! Special purchase of walnut trolley-type cabinets originally intended for use in projection T.V. Easily recognised as being of leading High Quality manufacturer's stock, heavy dark solid walnut. Can be easily adapted to house tape recorder, amplifier, radigram, etc., etc. Measurements external 24½in. × 16in. × 29in. The whole is mounted on castors. Unrepeatable bargain at **£5/19/6**, plus 10/- packing and carriage. We have a large selection of all type cabinets. A stamp will bring list.

CLYNE RADIO LTD.

18, Tottenham Court Road, London, W.1.

Manufacturer-to-Consumer policy saves you at least one-third cost.

Our Chief Engineer, who is operating a Technical Guidance Service, is available daily, including Saturdays, from 10 a.m. to 6 p.m., or will deal with enquiries by return of post. Our new illustrated Catalogue and Supplement will be a great boon to those desiring high quality equipment for modest expenditure. Send two 2½d. stamps for your copy now. It may well save you pounds. All our equipment is on demonstration at our showroom in conjunction with a variety of pick-ups, speakers, etc. If you can possibly call we shall be pleased to see and help you.

The New No. 1 "SYMPHONY" AMPLIFIER MARK III is a 3-channel 5-watt Gram/Radio Amplifier with astonishingly flexible tone control. You can lift the treble, the bass, or—and here is the unique feature—the middle frequencies to suit your own ear characteristics and the record or radio programme being heard. It is thus possible to arrange the frequency-response of the amplifier to a curve equal and opospite to the resultant curve of the other items in the chain so that what finally registers in the brain is as per original. This flexibility of control is even more important than the nominal linear response of the amplifier, as the pickup speaker, etc., are not linear. Independent Scratch-Cut is also fitted and special negative feedback circuit employed. The Amplifier can accommodate a wide variety of records from old 78s to new L.P.s, and there is full provision for Radio Tuner, Tape take-off and Playback. It is available to match 2/3 or 15 ohms speakers. Price **12 gns.** (carriage 5/-). Fitted in portable Steel Cabinet, **2 gns.** extra.

The New No. 2 "SYMPHONY" AMPLIFIER MARK III, as No. 1 but with 10-watt Push-pull triode output and triodes throughout. Woden mains and output transformers and choke. Output tapped 3, 7.5 and 15 ohms. Full provision for Tuner and Tape. Competes with the most expensive amplifiers on the market yet costs only **16 gns.** (carriage 5/-). Fitted in portable Steel Cabinet **2 gns. extra.**

"SYMPHONY" AMPLIFIERS WITH REMOTE CONTROL. Both the above model Amplifiers are available with all controls on a separate Control Panel with up to 4ft. flexible cable which simply plugs into the amplifier. Enables the Amplifier proper to be sat in the bottom of a cabinet whilst the controls are mounted conveniently higher up. Extra cost **2 gns.**

No. 1 "SYMPHONY" FM TUNER. High grade instrument with extremely silent background **£15/8/-.** Power Pack, **£3/7/6.**

No. 2 "SYMPHONY" AM/FM TUNER. Combining all the specifications of the Long, Medium and Short wave Superhet AM Tuner and our No. 1 FM Tuner. Separate Coil Assemblies and I.F.s Fully self-powered on one chassis. **26 gns.**

N.R.S. EMPRESS FM/VHF TUNER/ADAPTOR. Fine little job, will plug into any radio and add F.M. **£13/15/-.** Magic eye assembly **£1** extra if required. Ditto mounted in beautiful dark walnut cabinet complete with magic eye **16½ gns.** Carriage 7/6.

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Both complete with Studio "O" or "P" head.
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CHROME EXTENSION CAR AERIALS. 1 ft. to 4 ft. 13/6.

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500 microamps D.C.	2in. Flush square	27/6
1 m.a. D.C.	2in. Flush square	22/6
5 m.a. D.C.	2in. Flush square (scaled 0-100 m.a.)	10/6
10 m.a. D.C.	2½in. Flush circular (blank scale)	10/6
150 m.a. D.C.	2in. Flush square	7/6
200 m.a. D.C.	2½in. Flush circular	12/6
500 m.a. thermo	2in. Proj. circular	5/-
4 amp. D.C.	2½in. Flush circular	15/-
20 amp. D.C.	2in. Proj. circular	7/6
40 amp. D.C.	2in. Proj. circular	7/6
30-0-30 amp. D.C.	Car type moving iron	5/-
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159 RECEIVER UNIT. Contains 1 each valve, types EF50, EA50, SP61, RL37 and 24 v. selector switch. ONLY 7/6.

R.C.A. 8in. P.M. SPEAKER, mounted in heavy black crackled metal cabinet with chromium grill, and padded feet. Size 11½in. w. × 10½in. h. × 6in. d. Ideal for use with receivers or as an extension. BRAND NEW IN MAKER'S CARTONS. ONLY 45/-.

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FS43. 425-0-425 v. 200 m/a., 6.3 v. 4 a., C.T., 6.3 v. 4 a., C.T. 5 v. 3 a.	47/6
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PANORAMIC ADAPTORS. Visual display of signals on 3in. C.R. Tube 3BP1. Band width 200 Kc/s. Suitable for receivers with IF's of 450–475 Kc/s, e.g., CR100 and CR150. Operates from 115–230 v. A.C. mains. BRAND NEW as shipped ex-U.S.A. With instruction manual, **£30.**

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A.C. MAINS POWER PACK AND OUTPUT STAGE. These enable the R1155 to be used on A.C. mains WITHOUT ANY MODIFICATION Three types available, **£4/10/–, £5/5/–,** or de Luxe model with 8in. speaker, **£6/10/–.** ALL power packs guaranteed SIX MONTHS.

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RANGE	TYPE	SIZE		PRICE
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100 Microamp.	D.C. M/C	2½in.	Flush circ., scaled 0-1,500	39/6
500 Microamp.	D.C. M/C	2in.	Flush square, Weston	27/6
500-0-500 Microamp.	D.C. M/C	2½in.	Flush circular, scaled 100-0-100 V.	25/-
1 Milliamp.	D.C. M/C	2in.	Flush square, Fe/NFe	22/6
1 Milliamp.	D.C. M/C	2½in.	Desk Mounted type	32/6
10 Milliamp.	D.C. M/C	2½in.	Flush circular, blank scale	10/6
100 Milliamp.	D.C. M/C	2½in.	Flush circular	10/6
150 Milliamp.	D.C. M/C	2in.	Flush square	7/6
200 Milliamp.	D.C. M/C	2½in.	Flush circular	10/6
1 Amp.	Thermo-couple	2½in.	Projecting circular	6/9
4 Amp.	Thermo-couple	2in.	Flush square	6/9
20 Amp.	D.C. M/C	2in.	Projecting circular	7/6
30-0-30 Amp.	D.C. M/I	2in.	Proj. circ., car type	5/-
15 Volts	A.C. M/I	2½in.	Flush circular	8/6
300 Volts	A.C. M/I	3½in.	Flush circular	30/-
300 Volts	D.C. M/C	2in.	Flush square	10/9

METER RECTIFIERS. Salford Instruments, 1 mA, **8/6;** 5 mA, **6/9;** S.T.C., 2 mA., as used in E.M.I. Output Meter, **5/6.** All are full wave bridge and brand new.

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G.E.C. 200–250 v. A.C. mains input. 30 v. (tapped at 10 v.) 36 amps output. 5½in. x 6in. x 7in. high. Wt. 24lb., **55/–.**

SELENIUM BRIDGE RECTIFIERS. Funnel cooled. A.C. input 45 v. R.M.S. D.C. output 30 v. 10 amp. **47/6** each.

HEAVY DUTY SLIDER RESISTORS. 250 watts. Rated to carry 25 amp. .4 ohm resistance. For charging boards, etc. Worm drive. On metal stand 9in. x 4in. x 6in. high. BRAND NEW **7/6** each. ANOTHER, 12 amps, 1 ohm, 150 watts, **6/6.** ALSO 14 ohms, graded 1 to 4 amps., **7/6.**

RESISTORS. Latest miniature insulated Dubilier ½ watt type B.T.S. Wire ends. Useful values. ONLY **10/–** for 100 assorted! Erie, etc., ½ and ¼ watt, 1 gross assorted, **10/–.**

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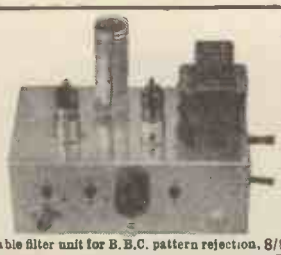

Kit of parts complete to build this most successful unit, comprising drilled chassis, valves, coils, res., cond., etc.; slightly modified version (Wireless World, May, 1954). £2/5/- post free. Send for blueprint and wiring diagram, 1/6 post free. Power Pack Components, including mains transf. and met. rect., 30/- extra. Provision has been allowed on chassis for Band 1-Band 3 switching. Suitable for most types of F/V sets, T.R.F. or superhet.

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16/450 v.	3/6	32/350 v.	4/-
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32/350 v.	4/-	50+50/350 v. ..	6/6
32/500 v.	5/-	60/350 v.	6/6
32+32/350 v. ..	5/6	60+250/275 v...	12/6
32+32/350 v. ..	6/6	64+120/275 v...	11/6
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SPECIAL.—Semi-air spaced polythene standard ¼in. diam. Stranded core. Feeder losses cut 50%. 9d. yard.
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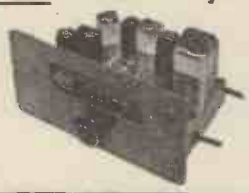
TYGAN FRET (Murphy pattern) 12in. × 12in., 2/-; 12 × 18in., 3/-; 12 × 24in., 4/-, etc.

JASON F.M. TUNER UNIT 87-105 m/cs



Kit of parts to build this modern and highly successful unit complete with drilled chassis and J.B. dial, wound coils and screened cans, 4 BVA miniature valves and all necessary quality components, etc., for only £6/10/- post free. Superior dial calibrated mc/s, edge lit by 2 pilot lamps, 12/6 extra. Power Pack components kit including double wound mains transformer, £2/5/- extra.
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Wire ends. Silicone coated. 25 ohms—10,000 ohms. 5 w., 1/3. 10 w. 1/6. 15 w. 2/-.
LINE CORD .3a 60 ohms per ft. 2a 100 ohms per ft., 2 way 6d. per ft., 3 way 7d. per ft.

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E.H.T. types. K3/25 2 Kv., 4/3; K3/40 3.2 Kv., 6/-; K3/45 3.6 kV., 6/6; K3/50 4 kV., 7/3; K3/100 8 kV., 12/6. etc.
Mains types. RM1 125 v. 60 mA., 4/-; RM2 125 v. 100 mA., 4/9; RM3 125 v. 120 mA., 5/9; RM4 250 v. 275 mA., 16/-.
RM4B type, 275 v., 276 mA., 17/6. LT types F/W bridge 6-12 v. 1½ a., 8/9; 3 a., 15/6; 4 a., 18/6; 6 a., 21/6 each.

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Midget log type, long spindles, all values 10,000 ohms to 2 Megohms. Less sw., 3/-; S.P. sw., 4/-; D.P. sw., 4/9. Linear types all values 10 ohms to 2 Megohms less switch 4/-. Guaranteed 12 months.

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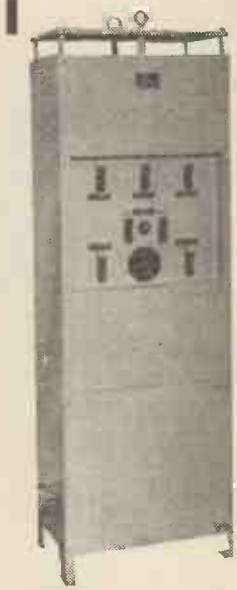

S.T.C. RECTIFIER SUPPLY UNIT No. 11 TYPE ZB 10235

Specification:—A.C. input 100-260 volts. 45-65 cycles. D.C. output 24 volts 11 amps. and 130 volts 600 m.a. very conservatively rated. L.T. and H.T. completely smoothed. All circuits fused. Mains on/off switch. Built in grey metal cabinet as illustrated. Height 5ft. 0in., width 1ft. 7½in.; depth 1ft. 1½in. Weight 200 lbs.
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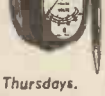

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EDDYSTONE SILVER PLATED PLUG-IN COILS. Five pin, 26 turns on ceramic formers, 2½in. dia. Brand new in maker's cartons. 8/6, postage 1/6. Ceramic bases for above, 2/–.

HEAVY DUTY 40 AMP. CONTACTORS. A.C. 220–240 v. 2 pole. Supplied brand new in maker's cartons. 32/6, carr. 3/–.

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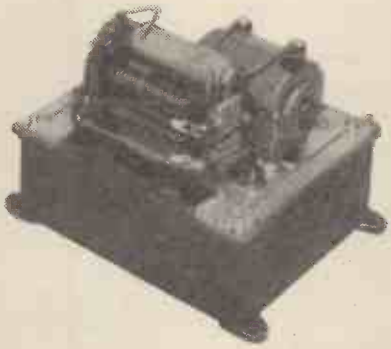
HOOVER MINIATURE GEARED FLASHER MOTORS TYPE E. 9 R.P.M. at 24 v. D.C. 4½ R.P.M. at 12 v. D.C.



Overall size of motor and gearbox 4¼ x 2¼ x 2in. Will operate on slightly higher voltage A.C. Mounted on metal box size 5½ x 4½ x 2¼in. which contains suppressor unit. SUPPLIED BRAND NEW IN MAKER'S CARTONS. 32/6, carr. 2/–.

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EMI 77	48/–	—	
EMI 88	35/–	21/–	
AGFA	37/6	22/6	
GEVAERT	35/–	21/–	
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RC88	£17 18 8
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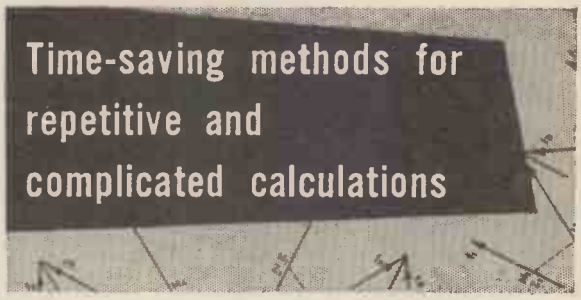

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APA-10	Panoramic adaptor	.5-3000 MC
APA-11	Pulse analyser	
APA-16	Bombsight marker	
APA-17	Direction finder	.25-1 KMC
APA-23	Auto. sig. recorder	
APA-38	Panoramic adaptor	10 MC band
APN-4A	Loran	
APN-4B	Loran	
APN-9	Loran, lightweight	
APN-7	Transponder, IFF	S-band
APN-19	Radar beacon	S-band
APQ-5	Blind bombing	
APR-1	Search receiver	40-3400 MC
APR-2	Search recr/recder	15-1000 MC
APR-4	Search receiver	38-4000 MC
APR-5	Search receiver	1-3.1 KMC
APR-6	Search receiver	6 10 KMC
APS-2	Airborne search	S-band
APS-3	Airborne search	X-band
APS-4	Airborne search	X-band
APS-6	Search/gun aiming	X-band
APS-10	Airborne search/nav.	X-band
APS-13	Aircraft warning	420 MC
APS-15	Search/blind bomg	X-band
APT-4	Radar jammer	165-780 MC
APT-5	Radar jammer	
APX1/2	Transponder, IFF	157-212 MC
CPN-3	Ground beacon	S-band
CPN-6	Ground beacon	X-band
CPN-8	Ground beacon	S-band
CPN-17	Ground beacon	S-band
SCR-682A	Harbour search	S-band
SCR-584	Ground radar	S-band
SCR-602	Ground radar	220 MC
SCR-720	Radar aircraft	S-band
TPL	Mobile ground	S-band
TPS-1	Ground portable	1100 MC
UPN-1	Radar, beacon, IFF	S-band
UPN-2	Radar, beacon, IFF	S-band
SD-SF-SG-SK-SL-SN-SO-SQ Navy Radar		
VC-VD-VE-VF-VG remote radar repeaters		

DYNAMOTORS—GENERATORS—INVERTERS

Type	Used with	Type	Used with
BD-77	BC-191	MG-149H	
BD-86		MG-153F	
BD-94		MP-10G	TA-2J-24
DA-19A	RTA-1B	PE-59	SCR-240
DM-21	BC-312	PE-73	BC-375
DM-28	BC-348	PE-75	MANY
DM-32	COMMAND	PE-77	EE-97
DM-33	COMMAND	PE-86	RC-19
DM-34	SCR-508	PE-94	SCR-522
DM-35	SCR-508	PE-95	SCR-499
DM-36	SCR-508	PE-98	SCR-523
DM-37	SCR-508	PE-101	SCR-515
DM-40	SCR-506	PE-103	SCR-284
DM-41	SCR-506	PE-104	SCR-284
DM-42	SCR-506	PE-108	SCR-543
DM-43	SCR-506	PE-109	SCR-269
DM-53	RC-103	PE-125	SCR-245
DM-64	SCR-808	PE-218	SCR-519A
DM-65	SCR-808	PE-237	SCR-694 and
DY-1	ARR-2X		GRC-9
DY-2	ARR-2	PU-7	VARIOUS
DY-9	ARC-1	PU-16	VARIOUS
DY-10	ARC-4	800-1	VARIOUS
DY-11	ART-13	PE-110	SCR-534
DY-12	ART-13	PE-112	SCR-518
DY-17	ART-13	PU-6/TPS-1	TPS-3
DY-21	ARC-3	PP-4	APQ
DY-22	ARC-3	PP-51	APQ
GN-35		PP-87	APT-4
GN-37	SCR-178	PP-104	APT-5
GN-45	SCR-284	RA-34	BC-191
GN-50	PE-162	RA-38	SCR-268
GN-58	SCR-694	RA-42	BC-639
HRU-28		RA-62	SCR-624
MG-149F		RA-87	TELETYPE

TELEPHONE AND TELEGRAPH

BC-1016	CW ink tape recorder
BD-71	6 line switchboard
BD-72	12 line switchboard
EE-8	Field phone
EE-65	Line test set
EE-99	Telephone repeater
RC-261	Remote control
TG-5	Code oscillator
TG-10	Ink tape reproducer
TG-34	Code practice keyer
TP-9	Long range field phone

Civilian and military telephone and telegraph centrals, carriers, switchboards, facsimile and teletype.

TEST EQUIPMENT

TS-3/AP	Power and freq. meter	S-band
TS-7/ASQ	Magnetic compensator	
TS-10/APN	Altimeter test set	Delay line
TS-12/AP	Standing wave ind.	X-band VSWR
TS-13/AP	Sig. gen. freq. mtr.	X-band
TS-14/AP	Sig. gen. pwr. mtr.	S-band
TS-15/AP	Fluxmeter	1.2-4.5K GAUSS
TS-16/APN	Altimeter test set	340-7250 CYC
TS-18/AP	Voltage divider	100 : 1-15 : 1
TS-19/APQ-5	Calibrator	491.04 MC
TS-23/APN	Altimeter test set	
TS-24/ARR-2	Test oscillator	246 MC
TS-27/TSM	Line test set	0-50 MEG, .1-3 MFD
TS-28/UPN	Synchroscope	
TS-32/TRC-1	Test oscillator	1 KC FM, 70-100 MC
TS-33/AP	Frequency meter	X-band
TS-34/AP	Portable oscilloscope	Fast sweep
TS-35/AP	Sig. gen. pwr. and freq. mtr.	X-band
TS-36/AP	Power meter	X-band
TS-45/APM-3	Power and freq. meter	X-band
TS-46/AP	Frequency meter	S-band
TS-47/APR	Signal generator	40-500 MC
TS-51/APG-4	Goniometer	
TS-56/AP	Standing wave ind.	L-band
TS-59/APN	Delay line altimeter	High alt.
TS-61/AP	Echo box	S-band
TS-62/AP	Echo box	X-band
TS-67/ARN-5	U/with RC103/ARN5	
TS-69/AP	Calibrator freq. meter	.4-1KMC
TS-74/UPM	Attenuator and phantom ant.	S-band
TS-75/U	Test meter	U/with TS76
TS-76/APM-3	Wave guide kit	U/with TS45
TS-78/U	Phantom antenna	100-156 MC
TS-89/AP	Voltage divider	X-and S-bands
TS-91/TPS-1	Echo box	1050-1110 MC
TS-92/AP	Broad band alignment	20-250 MC
TS-98/AP	Decade resistor	22.85 : 1
TS-100/AP	Oscilloscope circular sweep	
TS-102/AP	Range calibrator	Sine wave 327.8 KC
TS-108/AP	RF dummy load	X-band
TS-110/AP	Echo box	S-band
TS-111/CP	Wavemeter	S-band
TS-117/GP	Wavemeter, absorption	S-band
TS-118/AP	RF watt meter	20-1000 MC, 5-500 W
TS-120/UP	Sig. gen. pwr. meter	X-band
TS-125/AP	Power meter	S-band
TS-126/AP	Radar range calibrator	400 YD. PIPS
TS-127/U	Frequency meter	375-725 MC
TS-131/AP	Field strength meter	20-3000 MC
TS-133/UPM-1	Wavemeter	115-235 MC
TS-134/UPM-1	Wavemeter	460-570 MC
TS-146/UP	FM sig. gen. wave and pwr. mtr.	X-band
TS-147/UP	Sig. gen. pwr. freq. meter	X-band
TS-148/UP	Spectrum analyser	X-band
TS-155/UP	Pulse generator	S-band
TS-159/TPX	Sig. gen. pwr. freq. mtr.	150-200 MC
TS-170/ARN-5	Test oscillator	332.6-335 MC
TS-173/UR	Frequency meter	90-450 MC
TS-174/U	Frequency calibrator	20-280 MC
TS-175/U	Frequency calibrator	85-1000 MC
TS-182/UP	Signal generator	157-187 MC
TS-184/AP	Echo box	400-430 MC
TS-192/CPM-4	Wavemeter	S-band
TS-204/AP	Reflectometer	
TS-218/UP	Tuned cavity	X-band
TS-226/AP	Wattmeter to K KW	400-425 MC
TS-247/APM-48	Wavemeter	215-275 MC
TS-250/APN	Altimeter calibrator	Delay line
TS-251/UP	Loran sig. generator	1700-2010 KC
TS-258/UP	Sig. gen. pwr. and freq. mtr.	X-band
TS-259/AP	FM signal generator	
TS-263/TPS-10	Sig. gen. wattmeter	X-band
TS-268/U	Xtal rect. test set	
TS-270/UP	Echo box	S-band
TS-278/AP	Test set	400-420 MC
TS-297/U	Multimeter	
TS-309/U	Sweep generator	5-65 MC
TS-323/UR	Frequency meter	
TS-352/U	Multimeter	
TS-375/U	Voltmeter	
TS-382/U	Audio oscillator	100 KC
TS-505	Vac. tube voltmeter	
I-48	Megohmeter	0-1000 MEG
I-49	Wheatstone bridge	0-10 MEG
I-56	Tube tester voltohmeter	
I-72	Signal generator	100 KC-32 MC
I-83	Dynamotor test set	
I-86	Generator	470 MC
I-96A	Signal generator	100-156 MC
I-100	Radio ADF test set	
I-130A	Signal generator	100-156 MC
I-293A	Bolometer	S-band
I-208	Signal generator	1.9-45 MC
I-222A	Signal generator	8-230 MC
IE-17	Handy talky test set	
IE-19	SCR522 test set	100-156 MC
IE-36	SCR522 test set	
IE-46	IFF test set	156-166 MC
IE-56	IFF test set	160-186 MC
BC-221	Frequency meter	125-20000 KC
BC-376	Signal generator	75 MC
BC-1066	Test receiver	150-225 MC
BC-1077	Signal generator	S-band
BC-1203	Modulator unit	
BC-1277A	Sig. gen. pulsed	S-band
BC-1287	Oscilloscope	

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OZ4	5/6	6F15	14/-	10C1	12/6	EF41	11/6	PY81	10/-
1A3	3/6	6F6G	7/6	10C2	12/6	EF42	13/6	PY82	8/-
1A5GT	6/6	6F6M	7/6	10F1	12/6	EF80	10/-	PX25	13/6
1A7	11/6	6G6G	4/-	10F9	12/6	EF86	12/6	QP21	7/6
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1H5GT	10/6	6J5G/GT	5/-	12A6	6/6	EL2	12/6	SP220	6/9
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3A4	7/-	6L6G	9/-	12K8	11/-	EZ40	10/-	UCH42	11/-
3Q4	9/6	6L7M	7/6	12Q7	9/6	EZ41	11/-	UF41	10/-
3Q5	10/-	6N7	7/-	12SC7	2/6	EZ80	10/6	UL41	11/-
3S4	7/6	6Q7G/GT	9/-	12SG7	7/6	E1148	2/-	UY41	10/-
3V4	8/6	6SA7GT	8/-	12SH7	5/6	FW4/500	10/-	VR21	3/-
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5R4Gy	9/6	6SJ7GT	8/-	12SQ7	9/6	HL2	5/6	VR55	7/6
5U4G	8/-	6SK7	5/6	15D2	5/-	HLI320	12/6	VR56	6/-
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5Z4G	8/9	6SN7	8/-	25L6GT	9/6	HP211C	6/9	VR65	3/6
6A7	11/6	6SQ7	9/3	25U4GT	10/-	HP4101	5/-	VR65A	3/3
6A8GT	10/6	6SS7	8/-	25Y5G	9/9	IC2	9/6	VR66	3/9
6AC7	6/6	6U4GT	15/-	25Z4G	9/6	IN5	10/6	VR91	4/-
6AG5	6/6	6U5G	8/6	25Z6GT	9/6	KL35	8/6	VR91SYL	7/6
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6AM5	5/-	6X4	7/6	35Z4GT	8/6	KT61	13/-	VE118	4/-
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6AT6	8/9	7B7	9/-	225DU	8/-	KTW63	8/6	VR137	5/6
6B8	4/-	7C5	8/-	AC6/PEN	7/-	KTZ41	6/-	VR150/30	6/6
6BA6	8/-	7C6	8/-	ATP4	6/6	LP220	6/9	VP23	8/-
6BE6	8/-	7Q7	8/-	CBL1	13/6	MS/PEN	5/-	VS70	3/-
6BW6	8/6	7R7	8/6	DH73M	10/-	P61	6/9	VT52	8/-
6BW7	12/6	7S7	9/-	DM70	10/6	P215	5/-	VT501	6/-
6C4	7/6	7Y4	8/6	EAF42	12/6	PEN25	5/-	VU39	8/9
6C5GT	7/6	75	10/6	EB41	9/-	PEN46	7/-	VU64	9/-
6C6	6/6	77	8/-	EBC41	10/-	PEN220A	4/-	VU111	2/6
6C8	2/6	80	8/6	EBF80	11/-	PCC84	10/-	VU120A	3/-
6C9	10/6	807	6/6	EC91	9/6	PCF80	9/-	W77	8/6
6CH6	8/-	8D2	2/9	ECC31	8/6	PCF82	12/6	W61	8/-
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★ Easy to build. ★ Valves 6J7, 6K7, 6V6GT plus metal rectifier. Full instructions, point to point wiring diagram. Price £5/10/- each. Post and Packing 3/-. Circuit diagram and full shopping list 1/-. All components may be purchased separately.

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3-way mounting type

MT1
Primary: 200-220-240v.
Secondarys: 250-0-250 v., 80 M/A 0-6.3 v. 4 amp. 0-4 v. 2 amp. Both tapped at 4 v., each 18/6

MT2
Primary: 200-220-240 v.
Secondarys: 350-0-350 v. 80 M/A 0-6.3 v. 4 amp. 0-5 v. 2 amp. Both tapped at 4 v., each 18/6

MT3
Primary: 200-220-240 v.
Secondary: 30 v. 2 amps.
Taps at 3 v., 4 v., 6 v., 8 v., 9 v., 10 v., 15 v., 18 v., 20 v., 24 v., each 18/6

2/- packing & post on above transformers.

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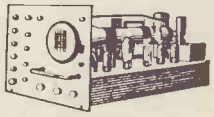
NR9A 2 volt: NR9B 4 Volt: NR9C 6.3 v.: NR9D 10.8 v.: NR9E 13.3 v. Price 10/6 each, all for use on receivers with own transformer.

NR14 Input 230/240 v., output 2-2½-2½-3 volts at 2 amps. 17/6 each.

NR12 Input 220/240 v. Multi output 0-2-4-6.3-7.3-10-13 volts, 25% and 50% BOOST. 21/- each.

NR15 Input 220/240 v. Output 6.3 v., with 25% and 50% BOOST. Price 17/6 each.

AMERICAN INDICATOR UNIT TYPE BC929A



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230 v. Input 4 volt 3.0 amp., each.... 10/6
230 v. Input 5 volt 2.0 amp., each.... 10/6
230 v. Input 6.3 volt, .5 amp., each.... 5/6
230 v. Input 6.3 volt 1.5 amp., each.. 6/6
230 v. Input 6.3 volt 3.0 amp. each.. 9/6
230 v. Input 12 volt, .75 amp., each.. 5/6

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20H, 250 ohms, 60 M/A. Clamp construction, each 6/-
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10H, 200 ohms, 150 M/A. Clamp construction, each 13/-
10H, 300 ohms, 40 M/A. Midget Clamp construction, each 5/3

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230 v. Input Tapped 6-12 v. 1 amp., ea. 13/6
230 v. Input Tapped 6-12 v. 3 amp. (Both with tap on Primary for 2.5 v. Pilot light), each 18/-

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Aerialite Coaxial plugs and sockets at 1/1 each.

Transformers T1154N, 25/- each.
Transformers T1154H, 37/- each.
Transformers T1154 in rough condition. 15/- each.
Carriage and postage on above transformers is 12/6.
Meters 0-100 m/a. panel mounting, 7/6 each.
Meters 0-5 amp. R.F. panel mounting, 7/6 ea.

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Lightweight 40 watt iron, with easily replaceable elements and bits. 200/250 v., price 16/9 each.

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12in. types by Plessey, lightweight unit ..... 35/- each
Goodmans 4in. x 7in. elliptical speaker ..... 19/6 each
8in. units with output transformer by Goodmans and Lectrona.. 22/6 each

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By Colvern, etc., all with ¼in. spindle. 5 ohms, 100 ohms, 200 ohms, 250 ohms, 500 ohms, 1K ohms, 5K ohms, 10K ohms, 20K ohms, 25K ohms and 50K ohms. All 2/6 each.

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Portable. AC/DC Mains/Battery Receiver, 4 valves (DK96, DL96, etc.), 2 wave-band Superhet in an attractive lizard grey case size 8¾" x 8¾" x 4½". Full kit of parts down to last nut and bolt. **£9.9.0**

Or if you prefer you can build the battery version first for £7.17.6 and add the mains components later. Post extra on kit 2/6.

Full circuit diagram, shopping list and point-to-point wiring diagram 3/-.

G.E.C. CABINET LOUDSPEAKERS. Cat. No. BC1955
8in. P.M. moving coil loudspeaker unit, 2/4 ohms with volume control in very attractive cabinet. Price 52/6 each, post 2/6.

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12 volt 1 amp., each 5/3
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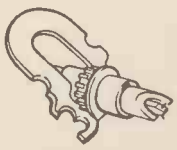

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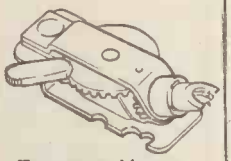

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17 inch RECTANGULAR, £7.10.0. 14 inch RECTANGULAR, £5.10.0.
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Complete chassis by famous manufacturer. R.F. E.H.T. unit included. Drawing FREE easily fitted to table or consol model, owing to this chassis being in three seperate units (Power, Sound & Vision, and Time Base) interconnected. THIS CHASSIS IS LESS VALVES AND TUBE, but see our catalogue for cheap tubes and valves. Our £5 tube fits this chassis. List of valves by request (stamp only) Carriage 5/- London. 10/- Provinces. Channels 1-5.

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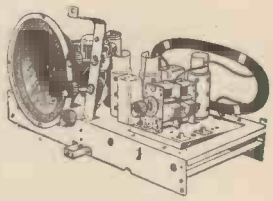

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3 LIGHT FITTING

SPECIAL PURCHASE FREE GIFT OF 3 SHADE BOWLS. Together with flex and lampholders. Not normally supplied except at extras. P. & P. 2/9.

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This convertor has been evolved since the I.T.A. transmissions began, and is based upon experience gained in the conversion of very many Band I sets in the London area.

IT will convert any set, any age, TRF or Superhet
IT includes station switching
IT provides pre-set contrast balancing
IT uses only one aerial input for both bands
IT provides manual tuning on Band III
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IT completely rejects unwanted signals
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CONVERTOR wired and aligned with fitting instructions	£4	2	6
KIT complete in every detail, less knobs	£2	12	6
KNOBS each		1	0
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For Cathode Ray Tubes having Heater/Cathode short circuit for C.R. Tubes with failing emission.
Type A. Low leakage windings. Ratio 1 : 1.25 giving a 25% boost on Secondary.

2 volt	10/6 each	With Tag
4 volt	10/6 each	Panel and
6.3 volt	10/6 each	Solder Tags
10.8 volt	10/6 each	
13.3 volt	10/6 each	

Ditto with mains primaries 12/6 each.
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All Isolation Transformers are individually boxed, labelled and clearly marked with relevant data.
NOTE:—It is essential to use mains primary types with T.V. receivers having series connected heaters.

RESISTORS. All values. 10 ohms to 10 meg., ¼ w., 4d.; ½ w., 6d.; 1 w., 8d.; 2 w., 1/-.
HIGH STABILITY. ½ w., 1%. 2/-. All preferred values 100 ohms to 10 meg.

WIRE-WOUND RESISTORS
5 watt, 10 watt, 15 watt — 25 ohms—10,000 ohms 1/3, 1/6, 2/-
15,000 ohms—50,000 ohms, 5 w., 1/9; 10 w..... 2/3

WIRE-WOUND POTS. 3 WATT LAB. COLVERN, ETC.
Pre-set Min. T.V. Type Knurled Slotted Knob. All values 25 ohms to 30 K., 3/- ea. 50 K., 4/-. Ditto Carbon Track 50 K. to 2 Meg. 3/-.
Standard size Pots., 2½in. Spindle High Grade. All Values, 100 ohms to 50 K., 5/6; 100 K., 6/6.
W/W EXT. SPEAKER CONTROL 10Ω 3/-.

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L.F. CHOKES 15/10 H. 60/65 mA., 5/-; 25/20 H. 100/120 mA., 11/6; 20/15 H. 120/150 mA., 12/6; 5 H. 250 mA., 15/-.
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465 Kc/s Slug tuning Miniature Can, 2½ × ⅞in. × ⅞in. High Q and good band width. By Pye Radio. Data sheet supplied.

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SLOW MOTION DRIVES. Epicyclic ratio 6 : 1, 2/3.
TYANA. Midget Soldering Iron. 200/220 v. or 230/250 v., 16/9.
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CRYSTAL MIKE INSERT by Acos, precision engineered. Size only 1¼ × 3/16in. Bargain. Price 6/6.
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6½in. ditto w/Trans, 21/-. 10in. Plessey, 30/-.
8in. M.E. 2.5 k. or 2 k. field, tapped O.P. transf., 24/6.
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40 CIRCUITS USING GERMANIUM DIODES, 3/-.
H.R. HEADPHONES, 4,000 ohms. Brand new, 17/6 pr.
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6½in. Spkr. Baffle Silk covered, 1/- each.
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2 p. 2-way, 3 p. 2-way, short spindle	2/6
5 p. 4-way, 2 wafer, long spindle	6/6
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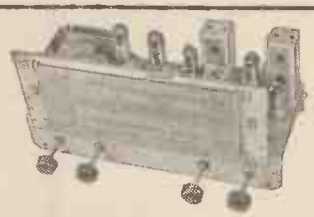
KNOBS. GOLD ENGRAVED. Walnut or Ivory. 1½in., diam., 1/6 each. "Focus," "Contrast," "Brilliance," "Brilliance—On/Off," "On-Off," "Volume," "Vol-On-Off," "Tone," "Tuning," "Treble," "Bass," "Wavechange," "Radio Gram," "S.M.L. Gram," "Record-Play," "Brightness," Ditto, not engraved, 1/-.



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THREE WAVEBANDS S.W. 16 m.—50 m. M.W. 200 m.—550 m. LW. 800 m.—2,000 m.
FIVE VALVES LATEST MULLARD ECH42, EF41, EBC41, EL41, EZ40
12 month Guarantee. A.C. 200/250 v. 4-way switch. Short-Medium-Long-Gram. A.V.C. and Negative feedback. 4.2 watts. Chassis 13½in. × 5½in. × 2½in. Glass Dial 10 × 4½in., horizontal or vertical available. 2 Pilot Lamps. Four Knobs. Walnut or Ivory, aligned and calibrated. Chassis isolated from mains.
T.S.L. Tweeter supplied free

BRAND NEW £10.10.0 Carr. 4/6

TERMS: Deposit £5.5.0 and 6 monthly payments of £1
MATCHED SPEAKERS FOR ABOVE CHASSIS. 8in., 19/6. 10in., 25/-; 12in., 30/-.

RECOMMENDED FOR ABOVE CHASSIS

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Collaro Autochanger RC531 for 78 R.P.M. 10in. and 12in. Records. Brand new in maker's boxes! High impedance, light-weight pickup with sapphire needle, will match any amplifier or radio. Less than half price. **£5.19.6** Carr. 5/6

Plessey

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TERMS: Deposit £4 and 6 monthly payments of 15/-
Brand new Plessey 3-speed Autochange Mixer Unit for 7, 10 and 12in. Records. Twin Hi-Fi Xtal Head with Duopoint sapphire stylus. Plays 4,000 records. Sprung mounting. Baseboard required 15½in. × 12½in. Height 5½in. Depth 2in. Super Quality. Post free. A.C. 200/250 v.

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AMPLION. 3-speed Single Record unit with Acos 37 Turnover Head, each Sapphire Stylus head plays 2,000 records. Starting Switch Automatically places Pick-up on records, 7in., 10in. or 12in. Auto Stop. Baseplate 12 × 8½in. Height 2½in. Depth 1⅞in. Price £7/15/6. Post free.

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For London, Midland and Northern Transmissions
Suitable for all T.V. makes. T.R.F. or Superhet
Ready wound coils, two EF80 valves, all components, punched chassis, circuit diagram, wiring plans. COMPLETE KIT for mains operation, 200-250 v. A.C. £3/10/-.

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Mains Transformer to above Spec....	10/6
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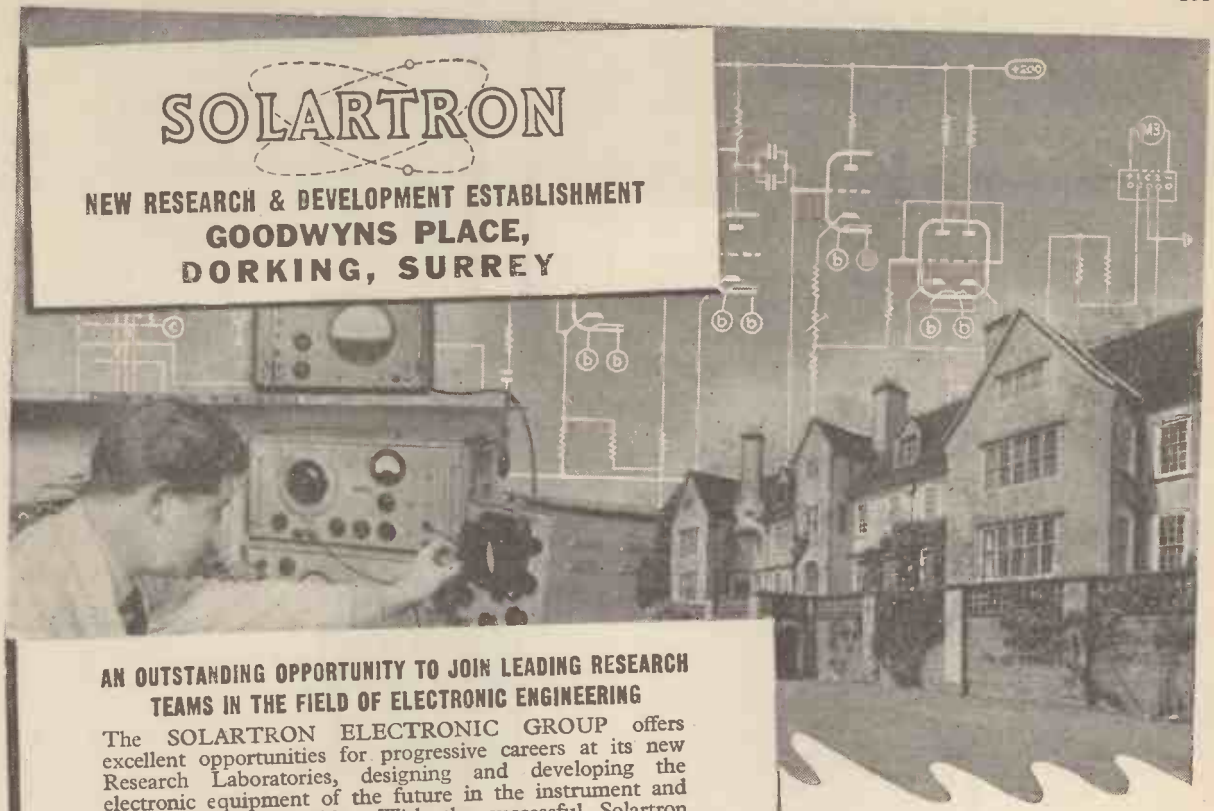

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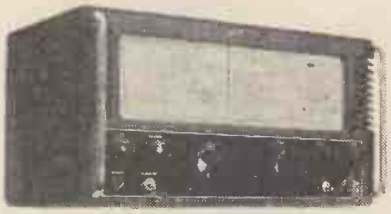

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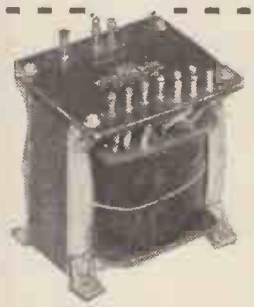

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potted

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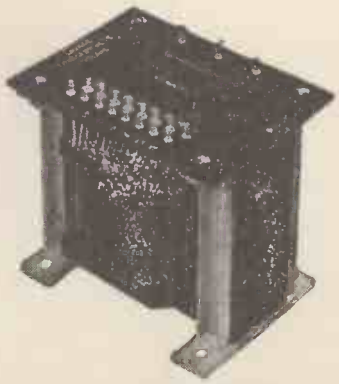

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R.A.F. Type 50

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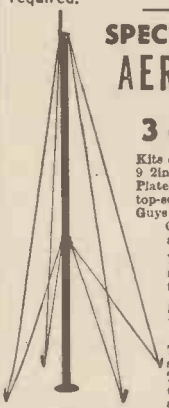

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SITUATIONS VACANT

ENGINEER required, experienced in television and radio, able to drive. Good salary. RITZ RADIO & ELECTRICAL Co., 306, Neasden Lane, N.W.10. Gladstone 4983. [6210

ENGINEERS, Physicists, Technicians and Laboratory Assistants are required by British Telecommunications Research, Ltd. VACANCIES exist in departments concerned with:—
(a) WIDE-BAND line communication systems;
(b) MEASURING and Testing equipment for above;
(c) Magnetic materials and semi-conductors;
(d) TRANSISTOR applications to above fields;
(e) WAVE filters, transformers and networks;
(f) ELECTRONIC switching and computing.
ATTRACTIVE posts are offered to appropriately qualified persons, and the appointments would be permanent.
THE company operates a superannuation scheme and offers very attractive working conditions with generous holiday and leave arrangements, and good social and recreational facilities. Summary of general conditions, etc., is available on request.
ALL applications will be dealt with in strict confidence and should be addressed to the Director of Research, British Telecommunications Research, Ltd., Taplow Court, nr. Maidenhead, Berks, quoting reference A/18. [6235

SENIOR and Junior Electrical and Mechanical Draughtsmen required for the Electronics drawing office at the Rugby Works of the B.T.H. Co., Ltd. Please apply in writing to:—CHIEF Draughtsman, Electronics Drawing Office, British Thomson-Houston Co., Ltd., Rugby, giving details of age, experience, etc.

COMPETENT television engineer required by firm who pride themselves on efficient service; permanency, good pay, assistance with accommodation.—Goulden & Wind, 42, High St., Deal, Kent. [6133

DRAUGHTSMAN required with experience of electronic equipment and circuitry.—Apply with details of experience and salary required to Parmeko, Ltd., Percy Rd., Aylestone Park, Leicester. [6225

APPLICATIONS are invited for the undermentioned posts which are vacant in the Telecommunications Laboratory of British Insulated Callender's Cables Ltd., at Kirkby, near Liverpool:—
ENGINEER to supervise work in connection with a wide variety of experimental measurements on Telephone Cables. The post involves liaison with the Cable Designers and the formulation and supervision of agreed measurement programmes. Previous experience in this type of work would be an advantage. Qualifications should include either a degree in Engineering or Physics or Corporate Membership of the Institution of Electrical Engineers.
JUNIOR Engineer to assist in the design and development of electronic test gear necessary for the testing and manufacture of Telephone Cables. Minimum qualification is National Certificate standard and candidates should possess a knowledge of valve applications.
GRADUATE Engineer for the design and development of Electrical Measuring Equipment for Telephone Cables. Candidate should be capable of liaising with Drawing Office and Model Shop for the production of prototype equipment. Previous experience in this type of work would be an advantage.
APPLICATIONS, quoting reference P/43/56, should be addressed to the Staff Officer, B.I.C.C., Ltd., Prescot, Lancs. [6172

INSTRUMENT Mechanics are required at the Calder Hall Works of the United Kingdom Atomic Energy Authority. Duties cover maintenance of instrumentation in reactors and chemical plants, also a wide range of specialized electronic equipment.
CANDIDATES must be experienced in industrial instrumentation or electronics either through apprenticeship or equivalent qualification.
TRAINING in maintenance of specialised instruments will be provided as necessary.
RATE of pay for a 44 hour week is 189/-. A Job Grading Scheme operates. The work is divided into three grades (A, B and C) and additional lead rates of 42/-, 30/- and 12/- respectively are paid.
MARRIED applicants living outside the daily travel distance of the Works will be given consideration for housing within a reasonable period after recruitment.
APPLICATIONS, giving details of apprenticeship, training (including Forces training), qualifications and experience to Senior Labour Manager, U.K.A.E.A., Industrial Group, Windscale Works, Sellafield, Cumberland. [6165

MULLARD, Ltd. (Valve Division) invite applications from suitably qualified candidates for the following vacancies dealing with preparation of published data on valves, tubes and semiconductor devices and enquiries concerning their application.
1. TECHNICAL assistant under 30 years of age, H.N.C. or equivalent educational standard.
2. TECHNICAL writer with H.N.C. or equivalent educational standard in radio or electronics. Previous experience of editing and publishing methods an advantage.
BOTH positions offer progressive salaries, bonus, staff pensions and the opportunity to obtain general experience in technical publication and the application of valves and similar devices in all branches of electronics.—Please reply giving full details to Personnel Officer, Mullard, Ltd., Century House, Shaftesbury Avenue, London, W.C.2, quoting reference No. 839. [6162

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A.C. MOTORS, 230 volts, sewing machine size, 35/- each.

IRON CLAD Safety Switches, 2 pole, D.P., D.T., 250 volts, 60 amp., new, 18/6, p/p 1/6 each.
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MOVING COIL Meters, all 2 to 3 inches dia., damaged cases or glasses, 3 for 10/-, guaranteed one sound meter; 6 for 18/-, two sound meters, no junk, all are or suitable for M/amp. meters.

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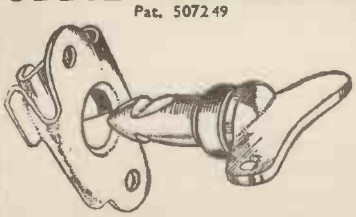

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TELEVISION engineer to join first class team in well equipped and organized service department. Top wages for 1st class man. Barnes & Avis Ltd., 35, London Street, Reading. [6170

OLD-ESTABLISHED London retail radio business requires television service engineer, also trainee; driving experience essential; good prospects for capable men; state age and details of experience.—Box 3380. [6242

McMICHAEL RADIO, Ltd., Slough, Bucks, have vacancies from time to time for electronic engineers to be engaged on Government projects; those wishing to be considered are invited to write fully to the Chief Engineer, Equipment Division. [0193

TV Engineer required for outside servicing; able to drive; old established company in North London area; permanency after satisfactory trial period; holidays arrangements honoured.—Write stating age, experience, to Box 3060. [6187

SENIOR Engineer required by Electronic component manufacturers to take charge of test gear development factory standards and maintenance of electrical special purpose plant. Permanent position requiring man with initiative and sound theoretical background. State salary required. Box 2930. [6164

SENIOR Development Engineering with experience of Transistor Circuitry, required for work on Miniature Electronic Equipment. B.Sc., or equivalent qualifications. Salary £900-£1,000. Apply to the Chief Engineer, Ardente Acoustic Laboratories, 62, Horn Lane, Acton, W.3. [6169

PYE Limited, Radio Works, Cambridge, invites applications for positions as Technical Authors and Illustrators for the compilance of Maintenance Handbooks dealing with radio equipment; applicants must possess command of English and some technical knowledge.—Applications in writing to Personnel Officer.

ELECTRONIC Test Engineers are required by the General Electric Co., Ltd., Radio and Television Works, Spon St., Coventry; ex-Service radio and radar technicians and men with similar experience are particularly suitable for these posts; applicants should have an interest in one of the fields outlined below:—
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(c) Development, manufacture and maintenance of test equipment.
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AN opportunity has arisen for a young, energetic Electronic Engineer of good education and pleasant personality to train for a position on the sales staff of well-established, progressive company, superannuation scheme.—Apply Managing Director, Electronics Division, Gresham Transformers, Ltd., Feltham, Middlesex. [6226

DESIGNER draughtsmen required by firm engaged in radio and electronic instrument work: experience in this field highly desirable: these are senior staff, pensionable appointments. Apply with details of experience and salary required to Personnel Officer, British Communications Corporation, Ltd., Exhibition Grounds, Wembley. [6114

GOOD class radio and television dealers have opening for another experienced engineer who would help to retain their high reputation for service, top salary plus bonus, commencing date with respect holiday arrangements, permanency; excellent opportunity in expanding concern for loyal, qualified man.—Sievers, Marsh Road, Pinner 9283. [6135

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E.M.I. DOMESTIC ELECTRONICS DIVISION have vacancies for Design Engineers to work in the field of magnetic recording equipment, high-fidelity and TV receivers; applicants should possess engineering degree or equivalent and have had several years experience in electronics; salary commensurate with ability.—Apply or write Personnel Dept., DED/10, E.M.I., Ltd., Blyth Rd., Hayes, Middx. [6191

DEVELOPMENT engineer required for Electronic Laboratory in established engineering firm. H.N.C., C. & G. in Telecomms., or similar qualification desirable, must be practical with some general design experience in electronic-mechanical devices including magnetic recording, pension scheme.—Write full particulars of previous career to S. E. Opperman, Ltd., Boreham Wood, Herts. [6160

ELECTRONIC Engineers; experienced in the design of high power audio-frequency amplifiers and test equipment, required to build up new department in expanding new field associated with aircraft and missile testing; unlimited prospects for enterprising engineers with determination and drive; London area; salary commensurate with qualifications and experience.—Box 2970. [6176

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LABORATORY Technician required for development of prototype electronic equipment; the immediate project involves ultrasonic equipment; City and Guilds or National Certificate qualification desirable, but practical experience essential; salary in accordance with qualifications and experience.—Apply, in writing, to the Director of Research, Research Laboratories, The British Aluminium Co., Ltd., Chalfont Park, Gerrards Cross, Bucks. [6171

PYE TELECOMMUNICATIONS, Ltd., Cambridge, require a Publicity Manager to handle advertising, sales literature, house magazine, public relations, home and export sales promotion, for a wide range of telecommunications and allied products; must have suitable experience; some technical knowledge would be an advantage but not essential; progressive position with ample scope for right man; preferably under 30. [6244

DECCA RADAR, Ltd., have vacancies in their development drawing office for Checker Draughtsman and Senior Draughtsmen. These vacancies offer an excellent opportunity to those desirous of advancement in a growing company engaged in the rapidly expanding field of navigational radar. Salaries in accordance with experience. Apply to The Chief Draughtsman, Decca Radar, Ltd., 9, Davis Rd., Tolworth, Surrey. [6245

G.E.C. require keen young men for interesting work in the field of electronics and sound reproduction. Training will be given to promising candidates who are at present taking a suitable course of study, and good opportunities will be available for gaining valuable design experience in these branches of engineering.—Apply in writing, quoting Ref. SD, to Staff Manager, Magnet House, Kingsway, W.C.2, giving full details of age and experience. [6134

ENGINEER for printed circuits required for development of printed circuit processes, including electro-plating of various metals, also development of printed resistors; qualifications B.Sc., or equivalent and experience of electroplating and/or carbon resistors is desirable; superannuation scheme.—Write, giving full details of qualifications, experience, age and salary required to Personnel Manager, The Telegraph Condenser Co., Ltd., Wales Farm Rd., North Acton, W.3. [6094

BRITISH EUROPEAN AIRWAYS require radio mechanics for routine maintenance on Viscount and Dakota aircraft at Manchester Airport on permanent night shift. Applicants should be prepared to undertake training and gain sufficient knowledge to enable them to obtain an M.T.C.A. licence after a reasonable time. Excellent pension, insurance scheme and sick pay benefits. Generous air travel concessions. Rate of 4/2¾d per hour, plus 5d per hour time workers' bonus, and 2¼d special bonus, plus individual proficiency pay varying between ½d to 3d per hour. Keen and fully skilled men who are interested in full employment with good future prospects should apply in writing, giving full details of age, experience and qualifications, to Station Superintendent, B.E.A., Ringway Airport, Manchester. [6246

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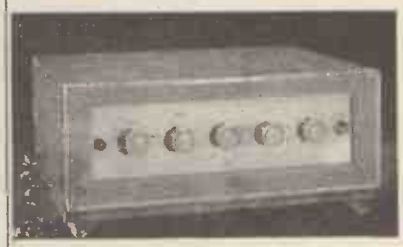

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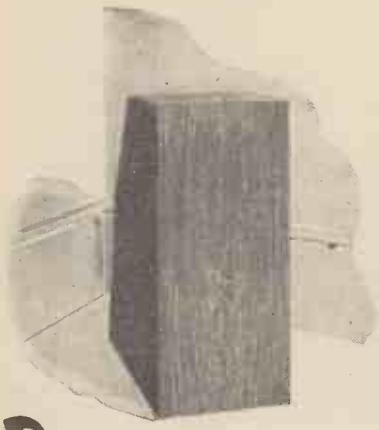

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JUNIOR Development Engineers and technicians are offered an opportunity to broaden their experience and scope to use their initiative in a newly-formed department primarily concerned with the development of electronic equipment for the Services; there are interesting positions for a number of grades of electronic engineers with or without experience in this field of development; those interested should write giving details of career to date to the Personnel Manager (Ref. JE), The General Electric Co., Ltd., Spon Street, Coventry. [6183

PHILIPS ELECTRICAL, Ltd., wish to fill a vacancy in the Radio and TV Division at head office; candidates should be graduate engineers under 28 years of age with a well defined aptitude for a commercial career; experience of work in connection with television equipment would be an advantage; the post carries an initial salary of not less than £650 per annum at age 25 and prospects of development and promotion are good.—Applicants should write giving fullest details of career to Personnel Officer, reference No. 824, Century House, Shaftesbury Avenue, London, W.C.2.

COMMUNICATIONS Engineer required for Middle East service with large oil company; not less than six years' experience radio transmission equipment; practical experience maintenance multi-channel carrier equipment and V.H.F. radio equipment; knowledge V.F. telegraph and automatic telephone exchange installations (non-director) useful; grade I.E.E. or H.N.C. qualified; age limit 35; bachelor preferred; total minimum emoluments £1,600 p.a.; paid home leave with passages.—Write, quoting No. 564, to Box No. 161, c/o Charles Barker & Sons, Ltd., Gateway House, London, E.C.4. [6174

REQUIRED for immediate employment in Venezuela: aircraft radio communications engineer for servicing and maintenance aircraft installations and v.h.f. ground stations; candidate must have at least 5 years experience servicing and maintenance of all types aircraft radio and communications equipment and be qualified by A.R.M.E. licence A or B; married or single men considered; starting salary according to experience; family pension fund.—Write giving full details experience, age, marital status, licences, etc., to Box ZE142, Deacon's Advertising, 36 Leadenhall Street, London, E.C.3. [6184

V.H.F. radio electrician fully conversant with siting, installation, maintenance and servicing of V.H.F. equipment required at a Mining property in the Gold Coast; duties require some work to be undertaken underground in addition to equipment on the surface; permanent employment offered; starting salary £79 per month; tours abroad are of 15 months followed by three months' leave on full pay; wife of new employee does not accompany on first tour but marriage allowance of £180 per tour paid; passages, furnished quarters and medical attention provided free; A staff assurance scheme is in operation.—Write, stating age and experience, to Box E7066, Whites, 72-78, Fleet St., London, E.C.4. [6179

A SMALL progressive manufacturer, located in South Bucks, offers a liberal salary for a Senior Electronics Engineer with suitable ability and experience. The successful applicant will be required to work in close liaison with the production unit and his duties will involve the development and application of transistor circuitry and the application of electronics to automation projects. A pension scheme is in operation and some assistance in the matter of accommodation can be provided. The location is exceptionally clean and healthy and yet within easy reach of London.—Full details of education, qualifications and experience should be tabulated under a covering letter to Box 7373 [6238

WAR OFFICE requires Temporary Technical Officer (Technical Grade I) at Malvern, Worcs, responsible for section engaged on writing technical reports and handbooks on repair and maintenance methods of Army Wireless Equipment, must have served full apprenticeship, hold H.N.C. or equivalent, sound technical background in all communication techniques, experience of all radio transmission and reception methods, VHF and FM in particular, test equipment for alignment and setting up of wireless equipment, experience in technical writing and possess qualities of leadership and tact; salary within range £860 to £1,070 according to age, qualifications and experience.—Forms from M.L.N.S., Technical and Scientific Register (K), 26, King St., London, S.W.1, quoting D 258/6A. [6163

BRITISH EUROPEAN AIRWAYS require radio maintenance engineers at Manchester Airport. Salary £14 4-£16/9 p.w. plus 12/6 p.w. special bonus. Shift pay. Applicants should have considerable experience of aircraft radio servicing and maintenance over a period of at least 4 years. Knowledge of modern airborne civil radio communications systems, landing and navigation aids, and recognized methods of routine test on such apparatus. Possession of a current Aircraft Radio Maintenance Engineer's licence to at least "A" category with "A" rating. Knowledge of aircraft electrical systems desirable, plus ability to supervise aircraft and ground equipment accumulator routine maintenance. Keen and fully skilled men who are interested in full employment with good future prospects should apply in writing, giving full details of age, experience and qualifications, to Senior Personnel Officer, Area and Outstations, B.E.A., Keyline House, Ruislip, Middlesex. [6247

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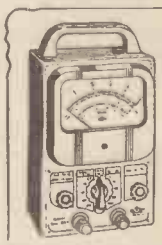

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APPLICATIONS are invited from radio engineers, preferably licensed, who would be interested in employment with British whaling company to work on Westland S.55 helicopters attached to Antarctic floating factory expeditions which depart each year October, returning April/May. Attractive terms include good salary and two months' holiday each summer. Preference given to applicants with experience of aircraft instruments and electrical systems.—Applications, with full particulars, to Chr. Salvesen & Co., 29, Bernard St., Leith.

THE GENERAL ELECTRIC Co., Ltd., Brown's Lane, Allesley, Coventry, requires mechanical development engineers, designer draughtsmen and draughtsmen, preferably with experience of radar-type equipments, for work on guided weapons and like projects; also required, senior and junior electronic development engineers particularly in the field of microwave and pulse applications; salary according to age, qualifications and experience.—Apply by letter, stating age and experience, to the Personnel Manager. Ref. R.G. [0259

A VACANCY occurs for a development engineer in a design group concerned with a wide range of small transformers of types used in radio equipment and electrical appliances, preference will be given to applicants having experience of this class of work, but young engineers with a sound basic training and limited experience will be considered and if successful will have the opportunity of gaining practical knowledge of design problems met in fulfilling commercial and military specifications, an attractive salary is offered together with good future prospects; the company's main laboratory is situated in the London area but there are also several vacancies in our Portsmouth unit.—Please reply, giving details of qualifications and experience to Box 3262. [6218

AIR MINISTRY requires Electrical Engineers at R.A.F. Radio Standards Centre, Hendon, Middlesex, for development of techniques for calibration of high grade radio test equipment involving output and attenuation measurements. Qualifications: Higher School Certificate (Science) or equivalent but H.N.C. or pass degree may be an advantage. Appointments according to age, experience, etc., as Experimental Officer (min. age 26) or Assistant Experimental Officer. Salary within range, E.O. £925-£1,135; A.E.O. £565 (age 18)-£805. Appointments at Hendon, but successful candidates expected to serve a short initial period at Henlow, Beds.—Forms from M.L.N.S., Technical and Scientific Register (K), 26, King St., London, S.W.1, quoting D 303/6A. Closing date September 14, 1956. [6216

D.S.I.R. requires Experimental Officers at Mechanical Engineering Research Laboratory, East Kilbride, Scotland; (1) Electronic Engineer (Ref. A260/6A) to supervise instrumentation in Plasticity Division Range of research—from metal physics, through properties of materials, to formation and machinery processes—offers scope for applying new techniques to measuring force, strain, torque, pressure, temperature and short-time intervals: (2) Metallurgist (F.543/6A) to work on high temperature mechanical properties of materials. Applicants should have experience of high temperature precision testing of engineering materials and particularly of creep testing. Successful candidate for this post would be required to work initially at National Physical Laboratory, Teddington, Middx, possibly for few years. Quals.: at least 26 and G.C.E. (Advanced) in two science or maths. subjects but Pass degree, H.N.C. in (1) Electrical Engineering or Physics; (2) Metallurgy, or equivalent generally expected; or for post (2) Final Certificate (Group Course) City & Guilds of London Institute in Metallurgy. Salary in range £875-£1,075 but post (2) will be £925-£1,135 until transfer to M.E.R.L. Women's pay slightly less. Equal Pay Scheme. East Kilbride offers good housing prospects.—Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting appropriate reference. [6215

GOLD COAST CIVIL SERVICE.—Vacancy for Assistant in Engineering Training (Radio Frequency) responsible for training in radio frequency subjects and organization of special course in the theory and operation of radio frequency equipment, will also be required to carry out some operational duties; candidates must possess a B.Sc.(Eng.) or other recognized Engineering Degree and have gained not less than thirteen years' professional experience subsequently or have passed one of the undermentioned examinations and have gained not less than fifteen years' experience subsequently: Sections A and B of the Associate Membership of the Institution of Electrical Engineers, Associate Membership of the British Institute of Radio Engineers (with Mathematics), Grade C examination of the B.B.C., full technological certificate of the City and Guilds Institute in Telecommunications. Candidates who are corporate members of the I.E.E. may be considered, provided they have gained not less than eleven years professional experience; appointment on one-two tour contract in the consolidated salary scale £1,950-£2,050 a year with a gratuity of £12/10 for each completed month of satisfactory service; free first class passages on appointment and leave for officer, wife and up to three children under 13 years of age; leave is granted at the rate of seven days for each completed month of residential service; kit allowance £30 may be payable; basically furnished accommodation provided at low rental; income tax at local rates.—Apply to the Secretary for Recruitment, Gold Coast Office, 13, Belgrave Square, London, S.W.1, for a form of application. [6192

SITUATIONS VACANT

MINISTRY OF SUPPLY requires Electronic Engineers at London H.Q. to plan and progress supply of wide range of electronic equipment with particular reference to ground radar equipment and installation of ground radar systems. Qualifications: recognised engineering apprenticeship or equivalent in electronics, A.F.R.Ae.S., A.M.I.C.E., Mech.E. or E.E. or exempting qualifications; should have thorough knowledge of ground radar equipment, particularly of types used by R.A.F. for control and interception of aircraft; experience in installation of radar or comparable equipment an advantage; salary within £765 (age 25)-£1,190.—Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1 quoting D270/6A. [6182

ELECTRONIC Engineers are required by the Equipment Engineering Department of Westinghouse Brake & Signal Co., Ltd., at Chippenham, Wiltshire, to take part in the development and subsequent engineering design for production of new control systems, employing electronic techniques, for traffic control on British and Overseas Railways. The scope of the work will range from practical experimental work to the issue of design instructions on which will be based manufacturing drawings, together with the compilation of manufacturing specifications and descriptive pamphlets. In addition, co-operation will be required with production engineers during manufacture of first-off equipments in the company's Chippenham works.

POSITIONS are available for University graduates with a good Telecommunication Degree in Electrical Engineering. Some experience with transistor techniques is required, together with experience of line communication systems employing audio and carrier frequencies. A knowledge of computing techniques would also be an advantage but is not essential.

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FOR further information, write giving age and full particulars to Personnel Superintendent, Westinghouse Brake & Signal Co., Ltd., Chippenham, Wilts, quoting Reference No. EQUIP/N/Q. [6237

TECHNICAL Assistant, Grade One, required for Kumasi College of Technology, Gold Coast, for two tours, normally of ten months. Option of appointment either (a) on agreement with prospect of permanent and pensionable employment with salary (including 5% non-pensionable addition) in scale £871 rising to £1,060 a year, or (b) on contract with salary (including 5% non-pensionable addition) in scale £958 rising to £1,166 a year plus gratuity at rate of £150 a year. Possibility of renewal of contract. Commencing salary according to experience. Outfit allowance £60 in certain circumstances. Furnished quarters available for officer and family. Free passages. Leave on full salary normally granted annually. Preservation of Superannuation rights under F.S.S.U. Scheme might be arranged. Candidates must possess H.N.C. or equivalent and have experience in research laboratories of manufacturer of telecommunications equipment or with an operating organisation. Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/41848/WF. [6168

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AIR MINISTRY requires Experimental Officers at Ruislip, Middlesex, for general experimental duties concerned with radio and radar installations employed in Royal Air Force. Duties include technical investigations into existing systems, field measurements, work on modifications and development of ancillary equipment. Qualifications: Higher School Certificate (Science) or equivalent qualification. Some experience of communications systems or radar control essential. Minimum age 26. Salary within range £900-£1,105.—Forms from M.L.N.S., Technical and Scientific Register (K), 26, King St., London, S.W.1, quoting D 302/6A. Closing date September 14, 1956. [6217

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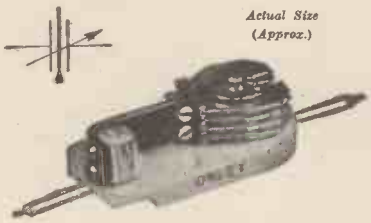

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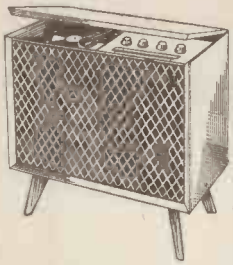

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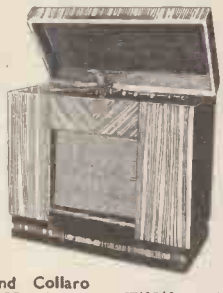

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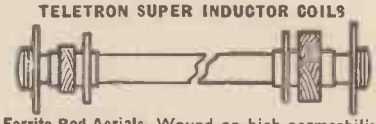

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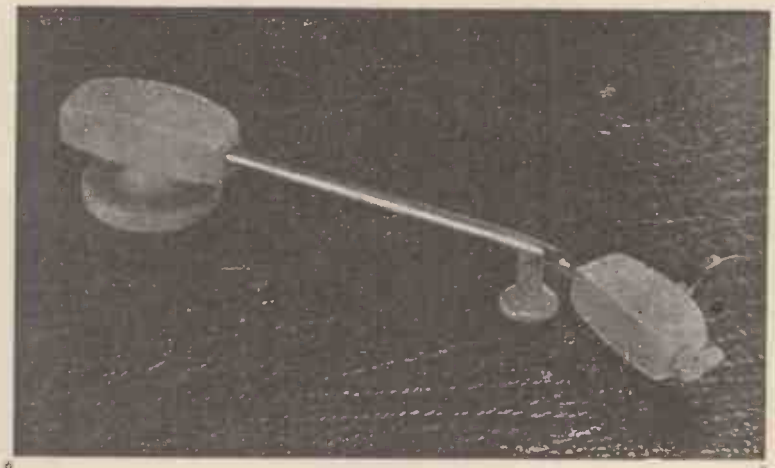

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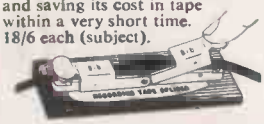

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